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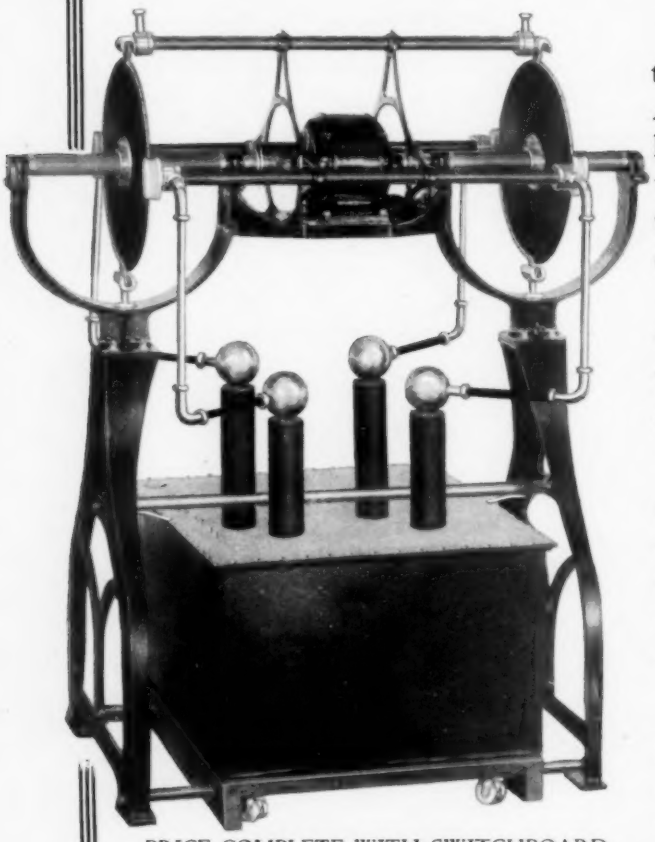

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THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

VOL. XI MARCH, 1924 No. 3

SPONDYLOLISTHESIS A COMMON LUMBOSACRAL LESION*

BY WILLIAM B. BOWMAN, M.D.

LOS ANGELES, CALIFORNIA

SPONDYLOLISTHESIS, a term usually applied to a forward and downward dislocation of the body of the last lumbar vertebra on the first sacral, is derived from the Greek word "spondylus" meaning vertebra and "olisthesis" a slipping downward or forward. Technically, this definition may be applied to the downward and forward dislocation of any of the vertebrae. This condition, according to most textbooks, is considered to be rather rare, and recent literature contains very little reference to this subject.

The spondylolisthetic pelvis was first described by Ropitanski who reported 2 cases in 1839, although Herbiniaux in 1782 reported a case which was evidently a spondylolisthesis. Neugebauer made a rather exhaustive study of this condition and collected 90 cases and specimens. Lovett analyzed 30 cases of subluxation of the fifth lumbar vertebra, 12 of the fourth lumbar and 1 of the first sacral. Palmer[1] states that the plane of the fifth lumbar vertebra on the sacrum has a tendency to allow the fifth lumbar to slide forward, and that the only structures which prevent this slipping are the ligaments, the fibers of the intervertebral disc, the iliolumbar and lumbosacral ligaments and the ligamenta subflava of the spinous processes. Any stretching or tearing of these ligaments may produce a spondylolisthesis. He also states that he may be theorizing, but I am of the opinion that it is a fact which can now be definitely proven. Darling[2] in 1918 published an article on this subject in which he states that violence is usually the true cause of spondylolisthesis, and that in many cases symptoms are few at the time of injury. It is his opinion that the onset is gradual, and the diagnosis ofttimes is made many months after the injury.

Numerous etiological factors have been mentioned by various authorities, among which are tuberculosis, fractures, congenital anomalies, destruction of the intervertebral disc, trauma or a slight back strain resulting from lifting. Roberts[3] states that the condition is not unusual in the laboring classes doing heavy work, and that carrying heavy weights and lifting play an important part in the etiology of this condition.

My object in presenting this paper is to show that spondylolisthesis or an anterior displacement of the fifth lumbar vertebra is by no means uncommon, but is present in many cases of injury of the lower back, and that it is a condition which is seldom correctly diagnosed, due, no doubt, to the fact that not enough attention is paid to getting detailed lateral roentgenograms of the lumbosacral joint. Many of the cases of so-called sacroiliac strain or dislocation which give negative roentgen findings in that region, but which are

* Read at the Twenty fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

improved or cured by manipulation by the orthopedist or attending surgeon, are, in my estimation, cases of spondylolisthesis.

A careful study of the lumbosacral joint in all cases of pain in the lower back examined in my laboratory during several months, many of them being seen immediately after injury, shows this condition to be exceedingly common. I have seen as many as 3 cases in one week.

Many times the injury was thought to be of minor importance and the examination was made simply as a precaution on account of its being an industrial accident case. The majority of my cases, by far, were the result of a fall. In some instances the patient claimed to have strained his back. Others complained of pain following the lifting of some heavy load. A few of them mentioned the fact that they felt something give way at the time of the lifting and that they were unable to proceed with their work. Others gave a history of pain in the lumbosacral region following the cranking of an automobile or auto-truck. Two patients reported their symptoms to have followed a sprain of the back caused by slipping without falling. A few of the cases gave no history of injury whatever, but of a gradual onset which grew progressively worse. The majority of cases were encountered in men, principally of the laboring type, although the 2 cases showing the most deformity were in women. Several cases of long standing gave the history of helpful manipulation by a chiropractor. Some cases were complicated by fractures or bone lesions involving the spinal column above the lumbosacral joint. It is also not uncommon to see this condition accompanied by a congenital anomaly of the fifth lumbar or first sacral vertebra.

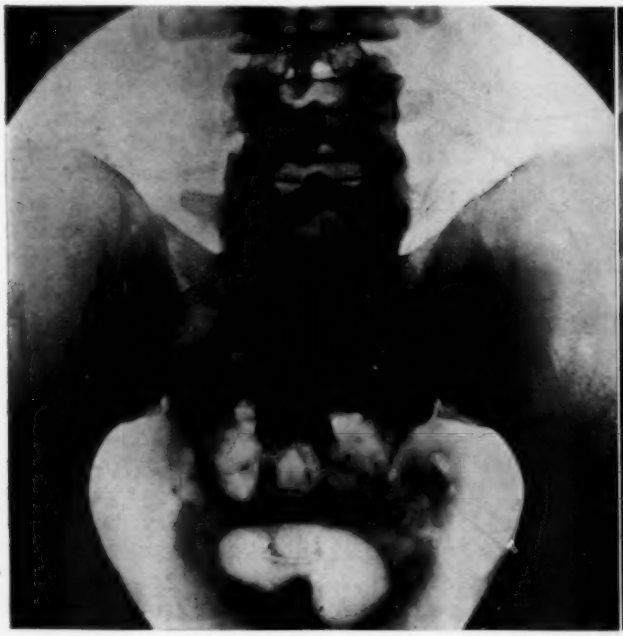

FIG. 1. Anteroposterior view of normal lumbosacral and sacroiliac joints.

FIG. 2. Lateral view of same normal lumbosacral and sacroiliac joints.

I am of the opinion that many of these cases are accompanied by fractures of the articular facets of these vertebrae which cannot be demonstrated roentgenologically.

The technique used in the examination of this region does not vary greatly from that described by both Hickey[4] and Groover.[5]

Anteroposterior roentgenograms of both the lumbar spine and sacroiliac region are first made with the patient lying flat on his back, feet together, toes turned up. Stereoscopic roentgenograms are advised

FIG. 3. Case I. Anteroposterior view.

FIG. 4. Case I. Lateral view showing anterior subluxation of the fifth lumbar vertebra with partial destruction of the posterior portion of the body of that vertebra, evidently due to a pressure necrosis.

FIG. 5. Case II. Anteroposterior view.

FIG. 6. Case II. Lateral view showing definite anterior subluxation of the body of the fifth lumbar vertebra.

and may be of additional assistance, but, in my own experience, I have never been able to make a definite diagnosis from the anteroposterior roentgenograms alone. Lateral roentgenograms are then made of the lumbar vertebrae and of the lumbosacral joint with the patient lying at right angles to the median plane in as comfortable a position as possible, so that there will be no movement. Occasionally it is necessary to elevate the shoulders or upper dorsal vertebrae by inserting a pad beneath the patient so as to keep the bodies of the lumbar vertebrae as nearly parallel to the plate as possible thereby eliminating a certain amount of unnecessary distortion.

One lateral roentgenogram should be made of the lumbosacral joint alone using a small cone and with the central ray passing directly through that joint. The diagnosis depends entirely upon obtaining a clear detailed lateral roentgenogram of that region.

The fact that these cases have not been diagnosed more frequently is due to the difficulty in obtaining good lateral roentgenograms of the fifth lumbar and first sacral vertebrae through the crests of both iliac bones. With the present modern equipment, super-speed films and double intensifying screens, this is now possible even in exceedingly heavy individuals.

REPORT OF CASES

CASE I (No. 6954). Female, aged forty. Five years ago slipped on wet pavement and fell backwards landing on back. Has had pain ever since, worse in sacroiliac region and radiating into both legs.

FIG. 7. Case III. Anteroposterior view.

FIG. 8. Case III. Lateral view. This patient also had compression fractures of the bodies of the first and second lumbar vertebrae.

Roentgen Findings. Anterior subluxation of body of fifth lumbar vertebra. Considerable pressure necrosis of posterior portion of the body of that vertebra.

CASE II (No. 17674). Female, aged thirty-six.

Patient had no definite history of injury. Developed a pain in sacroiliac region which is gradually increasing and now radiates into right leg. Has become markedly worse last two months.

Roentgen Findings. Marked anterior subluxation of the body of the fifth lumbar vertebra.

CASE III (No. 18240). Male, aged forty-two.

Three months ago patient fell distance

of 20 ft. landing on back. Pain in dorsolumbar junction and in sacroiliac region radiating into both legs.

Roentgen Findings. Compression fractures of bodies of first and second lumbar vertebrae. Slight anterior subluxation of the body of the first sacral vertebra.

CASE IV (No. 13548). Male, aged fifty-two.

Fell from six foot platform this morning, landing on floor. Pain in sacroiliac region. Worse on movement. Also pain in neck.

Roentgen Findings. Anterior subluxation of body of fifth lumbar vertebra, also fracture of right articular facet of first sacral vertebra.

CASE V (No. 13569). Male, aged twenty-nine.

Six weeks ago patient was on street car when it collided with truck and he was thrown from front door to center of car, landing on back. Constant pain in entire spine radiating into right leg.

Roentgen Findings. Anterior subluxation of fifth lumbar vertebra. Fracture of inferior articular facet of fifth lumbar vertebra. Partially sacralized last lumbar.

CASE VI (No. 11761). Male, aged forty-four.

Four weeks ago patient fell 12 ft. from a scaffold, landing on back. Pain in sacroiliac region ever since.

Roentgen Findings. Patient has an extra sacral vertebra. Fifth lumbar is displaced slightly forward on body of first sacral. Considerable rotation of bodies of all lumbar vertebrae.

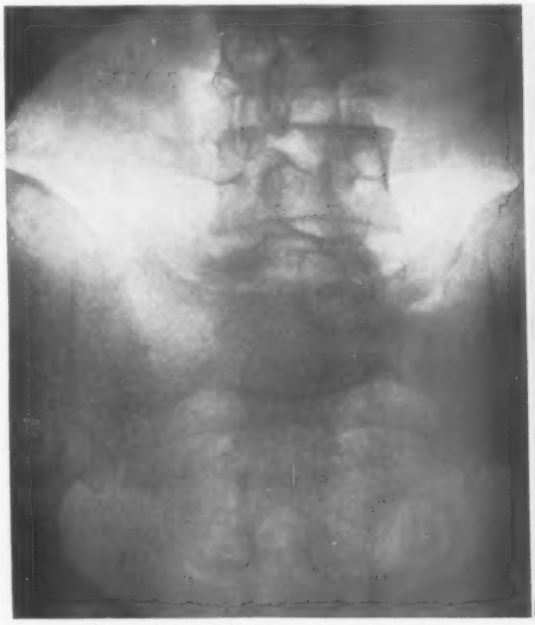

FIG. 9. Case IV. Anteroposterior view.

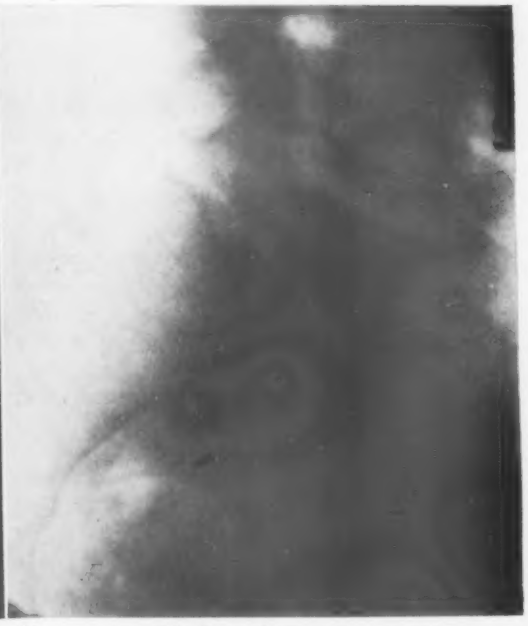

FIG. 10. Case IV. Lateral view showing slight anterior subluxation of the fifth lumbar vertebra.

CONCLUSIONS

1. Spondylolisthesis is not an uncommon condition. It is a common cause of pain in the lower back as shown by the frequency with which it occurs in lower back injuries.

2. It is usually the result of trauma, the injury often being considered of minor importance.

3. The symptoms are often not so severe as you would expect with this type of lesion, but are prone to get progressively worse after injury.

4. Many of the cases now diagnosed as sacroiliac dislocations by the attending physician or surgeon that cannot be demonstrated roentgenologically are, in reality, cases of spondylolisthesis.

5. Clear detailed *lateral* roentgenograms of the lumbosacral region are absolutely essential in diagnosing these cases.

6. In all cases of pain in the lower back, an examination of these regions should be made.

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ABSTRACT OF DISCUSSION

Dr. Dachtler said that the condition described by Dr. Bowman is much more common than lesions in the sacroiliac region, or at least we are more able to diagnose them. He also cautioned against making a diagnosis of compression fractures of the fifth lumbar vertebra unless the evidence is absolutely convincing.

Dr. Pfahler emphasized the fact that there is such wide variation in the normal in the fifth lumbar vertebra and in the lumbosacral joints that we must use great care in interpretation of the roentgen findings.

Dr. Edmonson spoke of the necessity for the legitimate practitioner to inform himself about the treatment of these cases so that there would be no excuse for their applying to chiropractors for treatment.

Dr. Holmes said that it is a well-known fact that complete luxation of the fifth lumbar vertebra does occur and if there are complete slips, it is reasonable to believe that there are partial slips. He said that Goldthwaite and Adams had called attention several years ago to the fact that the lumbosacral joint was a much less fixed joint than the sacroiliac and that a large proportion of the so-called sacroiliac sprains are really slips of the fifth lumbar. He called attention to the necessity for getting a true lateral view and for judging the amount of displacement by the alinement at the posterior instead of the anterior aspect of the body of the vertebra.

Dr. Keith said that he had been able to obtain better lateral views of the lumbar spine and pelvis by inflating the colon with air.

Dr. Bowman, closing the discussion, verified the statement that in his experience fracture of the fifth lumbar vertebra is very uncommon. He emphasized Dr. Pfahler's remarks upon the difficulty of recognizing abnormalities in the lumbosacral region because of the many variations in the normal, and stated that diagnosis of abnormality should be made only upon demonstration of an actual subluxation. He prefers to check the alinement of the fifth lumbar vertebra along the posterior, that is, the anterior wall of the spinal canal, rather than along the anterior aspect of the body of the vertebra.

BONE DYSTROPHIES OF VARIOLA*

BY J. W. CATHCART, M.D.

EL PASO, TEXAS

TWO things seem pertinent to a discussion of bone dystrophies in variola. Is there a specific bone lesion, and if so, does it occasionally produce changes in developing bone that have distinctive roentgen-ray characteristics?

The first seems clearly and definitely shown by the works of Chiari and Mallory, and the second by roentgenograms of unvaccinated individuals who had variola during the first-age period, and who, with no history of trouble in the bone other than that present at the time they had variola, now have well-marked dystrophies.

Chiari[1] in 1891 performed 22 autopsies on variola cases, 5 concerning the eruptive stage, 9 the suppurative and 8 the drying stage of the disease. He also performed 2 autopsies on children nine years of age, who died two and two and a half months respectively, post variolum. In all bones examined, non-suppurative, sterile, necrotic foci were found in the bone marrow. The more advanced the disease, the more necrotic the foci, and in one of the children who died of marasmus, two months after recovery from variola, the autopsy notes read as follows: "Bone marrow from the right femur showed isolated nodular pale foci near which contraction of necrotic tissue had set in; obliterated structures of bone marrow substituted by fine and coarse granular detritus representing resorption process in necrotic foci."

Mallory,[2] after examining microscopically all classes of bones from 14 patients dying of variola, concludes that in variola the marrow from various bones shows more or less numerous circumscribed typical inflammatory foci associated with central necrosis due to variola infection, with the foci more numerous in the short bones.

He found that migration of leucocytes was insignificant, and no pus formation was ever observed in the bone marrow. The necrotic area was invariably surrounded by an inflamed zone with typically swollen osteoblasts and serous and fibrinous exudate. The progressive extent of central necrosis was indicated by fragmentation of the nuclei within the inflamed zone.

It seems probable that patients of the first-age period who have variola may have necrotic areas in the bone marrow so situated as to involve the ossific centers. The disturbed ossific centers may alter the future development of the bone, causing the epiphyseal cartilage to disappear and the longitudinal growth of the bone to be inhibited. The epiphysis may become altered in configuration and irregular in outline. Ankylosis, fusion and exostosis are quite frequently seen. The lesions may be multiple and may involve any of the bones and joints, although the long bones and their articulations are more frequently affected. Cases with deformities have been reported where the variolar infection occurred from three to fourteen years of age—the greater deformities occurring in the younger children.

Musgrave and Sison,[3] in 1910, reported 8 patients who were admitted to their service in the Philippine Medical School and who were suffering from deformities of the forearms and hands caused by variola contracted during childhcod. In 1913[4] in a further report they state: "We had the opportunity to study several other cases of which 12 are briefly reported." Twenty cases in all were reported, 18 with photographs and 2 with roentgenograms. All were native Filipinos.

Sheldon[5] reported 2 cases with characteristic deformities in Chinese.

We have had 2 cases referred for roentgen examination in which we consider the bone lesions characteristic of variola, and through the courtesy of Dr. W. L. Brown[6] we are reporting them.

CASE I. American girl, aged six, face covered with variolar scars. Had variola three years ago while living in Mexico; was seriously ill and was in bed three months. During the last six weeks of her illness her arms and legs were so sore that

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

she could not be moved. It was thought that she had rheumatism. She had one small abscess on the inner side of the left tibia just above the ankle joint which was opened on two or three occasions, and which healed after the bone was scraped. From the time of that illness until the present time, three years, she has been gradually developing deformities of the forearms and wrists.

Roentgen Report. Left forearm: Ulna extends approximately 2 cm. beyond the radius deflecting the hand sharply to the radial side. There is an area of decreased density involving the lower end of the diaphysis for a distance of 2 cm., which is suggestive of old necrosis. Radial shaft slightly bowed and thickened. The distal epiphyseal line is obliterated and the articular surface appears small and forced back into the shaft, with the shaft partially overlapping it.

Right forearm: Bones forming the elbow-joint appear normal except for obliteration of the radial epiphysis. The shaft of the radius is bowed outward. The lower epiphyseal lines of the ulna and radius are obliterated at the wrist. The articular ends are irregular and uneven in outline; the shaft overlaps slightly the impacted articular end of the bone.

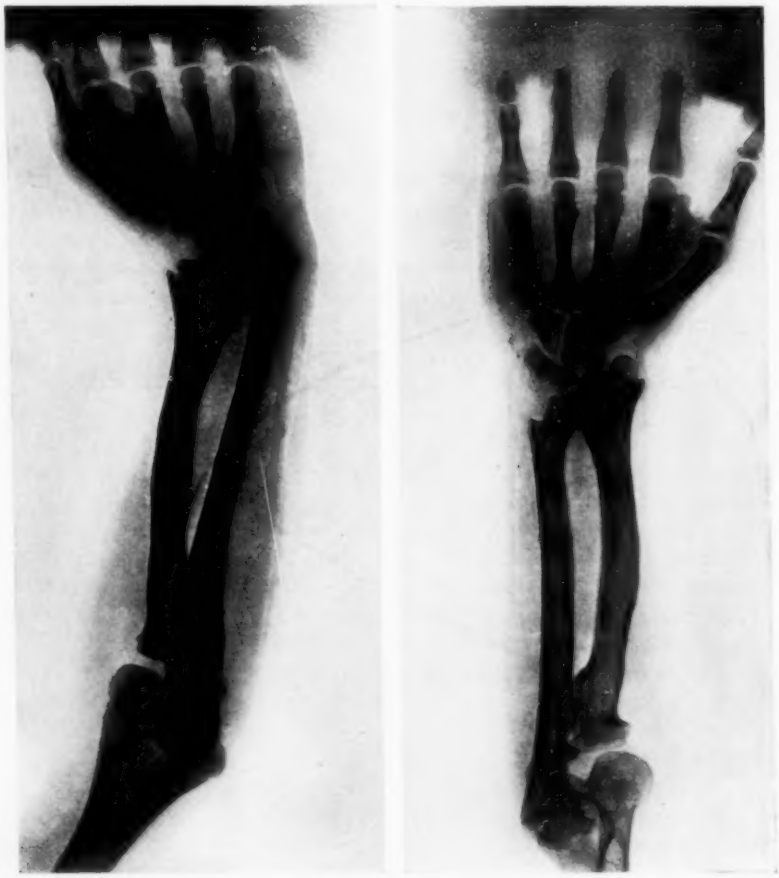

FIG 1. Case I.

Left leg: Evidence of old necrotic area lower outer aspect of tibia. Light area suggestive of necrosis in fibula 5 cm. above tip of malleolus.

Right clavicle: 2 cm. shorter than the left. Outer articular end is small and irregular.

CASE II. Male, Mexican, aged twenty. Born and reared in the interior of Mexico.

Face badly pitted from variola. So young when he had variola that he does not remember it. Has characteristic shortening of right forearm with ulna extending beyond the radius so as to deflect the hand to the radial side. The arm, while limited in supination and pronation, is sufficiently strong to permit ordinary manual labor. No external evidence of suppuration.

FIG. 2. Case II.

Roentgen Report. Left forearm: Ulna extends 3 cm. beyond distal head of radius deflecting hand sharply to the radial side. The distal head of the ulna is cone-shaped with partial absence of the articular surface.

Radius: The shaft of the ulna has fused to the distal head of the radius forming a firm bony union. There is increased density with roughened borders at the distal epiphysis suggestive of old inflammatory changes. The proximal ends of the radius and ulna are negative.

Comparison of length of right and left forearms:

Left radius 27 cm. Right radius 15 cm.
Left ulna 29 cm. Right ulna 22 cm.

CONCLUSIONS

In variola necrotic foci are scattered throughout the osseous system, and when the disease is sufficiently extensive, ossific centers in developing bone may be destroyed and the growth of the bone inhibited, producing marked deformities.

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DISCUSSION

DR. D. B. PHEMISTER, Chicago. Drs. Brown and Cathcart sent me a roentgenogram of their first case before I knew of Musgrave's work. I was inclined to consider the condition one of multiple osteomyelitis of the metaphyseal regions due to pyogenic organisms entering through the skin eruption. However, the fact that six lesions had resulted in destruction of the epiphyseal cartilage and arrested longitudinal growth of shafts was strongly against this view. Since learning of Musgrave's observations in the Philippines, I believe that the lesion must be the result of the smallpox virus. The bone marrow lesions described by Mallory are small and multiple and it is surprising that a small lesion should destroy the epiphyseal line when it escapes so frequently in very extensive pyogenic osteomyelitis. Further work on the bones of children dying of smallpox will be necessary in order to clear up the exact nature of the pathology.

TELEOROENTGENOGRAPHY AS AN AID IN ORTHOPEDIC MEASUREMENTS*

BY PRESTON M. HICKEY, M.D.

ANN ARBOR, MICHIGAN

THE writer has been impressed with the difficulty of making accurate measurements of the length of the limbs in orthopedic work. The inherent difficulty of accurately recognizing the anatomic landmarks so that they can be used for methods of measurement has always been an obstacle in the accurate measurements of the femur, tibia, and other bones. It occurred to the writer that by the use of teleoroentgenography the shadows cast upon the roentgen plate by the long bones might be used as an accurate means of measurement. Accordingly, at first, two 14 × 17 cassettes were placed end to end, the patient placed upon the floor with the cassettes underneath the parts to be measured, and the exposures made with a tube film distance of 7 ft. The results obtained this way were sufficiently encouraging to warrant the working out of a more precise technique. In placing two 14 × 17 cassettes end to end there was naturally a gap between the films due to the presence of the metallic edge of the film holders. At first a long strip of lead was placed alongside the patient's limbs, and this lead shadow was used in the accurate matching of the films. As this was cumbersome, one of the cassette manufacturers very kindly made a long cassette which was fitted with two sets of 14 × 17 intensifying screens accurately matched and placed end to end. This gave a total film length of 34 in. and a width of 14 in. In trying out this method it was found that the error which would occur from distortion was so slight as to be negligible.

The procedure, therefore, is to place the special cassette containing the films upon the floor, extend the patient carefully upon the cassette and raise the tube to the limit of the tube stand. In the observations that have been made, the tube film distance has been about 7 ft.

An interesting feature of these examinations is that by the use of teleoroentgenography, the blurring due to scattered radiation has been minimized so that satisfactory exposures have been made through the thicker parts of the body, where we are now accustomed to use the Potter-Bucky diaphragm. The exposure necessarily is lengthened, but owing to the fact that these measurements have been made only in parts which are not moved by respiration, the lengthening of the exposure does not inconvenience the patient. Inasmuch as the quantity of radiation diminishes with the square of the distance, the long exposures do not entail any more risk of a dermatitis than if the exposures were made in a shorter time with a shorter tube film distance.

This method has been tried out in cooperation with the Bone and Joint Department of the University of Michigan Hospital, and has been found to be a very useful procedure in making accurate measurements of the lower limbs in normal and pathologic bone conditions. It has been found most useful in the measurements of the femur and tibia in cases of congenital dislocation of the hip, and also in cases of a hypoplasia due to the late results of anterior poliomyelitis, tuberculosis of the hip, etc. It is also an accurate method in measurements of cases where shortening is suspected following fracture.

The writer submits this method of more accurate measurements with the idea that, while it probably will not be adopted as a routine procedure, it will be found useful in selected cases where the surgeon may wish to have an accurate measurement of the length of the bone, especially in cases which he wishes to keep under observation for a considerable length of time.

DISCUSSION

DR. PHILIP LEWIN, Chicago. There is one point about teleoroentgenography that I think is very important. That is, in a case with one short leg, difference in height of posterosuperior iliac spine dimples, with a curvature of the spine, where in order to level up the pelvis,

*Read at the Twenty-fourth Annual meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

the surgeon is going to remove a piece of bone from the femur of the opposite side. The inaccuracy of these measurements is well known when they are made from the anterosuperior iliac spine down to the lower border of the internal malleolus, but I think here is a method that tells you accurately how much of the femur you should take out, if you are going to take out any, in order to level up the pelvis in these cases of inequality of length of legs with curvature of the spine.

I would refer you to an article in the *Journal of the American Medical Association*, March 18, 1922, in which I discussed the subject of leveling the pelvis in cases of inequality of the length of the legs.

ROENTGENOLOGICAL EVIDENCE OF APPARENTLY HEALED MILIARY TUBERCULOSIS OF THE LUNGS*

BY EDWARD S. BLAINE, M.D.

CHICAGO, ILLINOIS

IT has been the experience of a few roentgenologists to encounter occasionally an unusually rare and startling film of the thorax in which numerous shot-like shadows are evenly distributed over both pulmonary fields. The significance of these shadows is of great interest to those engaged in the roentgen method of medical diagnosis, and is the basis of this presentation. I have encountered several such cases, three of which are detailed herewith, in which the roentgenographic findings were quite similar.

The major roentgen-ray findings consist of the presence of multiple, disseminated shadows of rounded outline and marked degree of density, having sharply bordered edges, all of which are very small in size (not over 3 mm. in diameter at most). These shadows are spread evenly all over both lung fields, no portion being free and no part containing more than another area. The areas between these small, hard shadows present normal roentgen-ray transparencies. The degree of shadow density is that found in local calcification of soft tissue structure such as is often seen in or near the lung root areas in many healthy adult individuals. The individual shadows are distinctly discrete and well separated from each other, no coalescing or merging being present. In none of the three cases observed is there any degree of fibrosis of the lung.

To one familiar with the roentgen-ray shadow appearance of acute miliary tuberculosis, the similarity of distribution of the abnormal shadows with those the subject of this study, is striking. In the acute form the shadows are more numerous, are smaller in size, soft and hazy in outline, and lie very close to each other; all of which results in a mottled appearance of the lung fields. The individual shadows of acute miliary tuberculosis lack both the degree of density and the sharply bordered edges of the healed calcified tubercle.

Having in mind the morphology of the active as well as the inactive or healed tubercle, one can find a rationale in explanation of the particular roentgen findings in question. Obviously, these shadows individually do not represent the beginning of a single tubercle, inasmuch as this is of microscopic size. When fully developed, however, it reaches the size of a millet seed (from which the term "miliary" is taken) which measures from 2 to 3 mm. in greatest diameter. This is of sufficient size to be projected on the roentgen-ray film, the resultant shadow area being larger than the lesion itself, provided the tubercle has undergone degenerative changes in which an increase of tissue density occurs—as for example, calcification. Even small areas of caseation necrosis, when surrounded by normal aerated lung tissue providing a marked contrast of density, will cast roentgen ray shadows which, though small, can be visualized. It is well known that every roentgen-ray shadow, regardless of what structure it represents, is an enlargement of the size of that structure, and this assists in projecting

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

the unit lesion of tuberculosis, provided it has undergone the tissue changes already referred to.

The pathologist (Schmauss-Ewing) informs us that "in tissues entirely fibrous and scar-like or calcified, no living bacilli are found, and inoculations of animals with such material remain negative, while from caseous foci, infection is always possible. Hence, tuberculosis is curable, and at times heals spontaneously. The remains of tuberculous collections in the lungs are frequently accidentally found at autopsies after death from other causes."

Osler and McCrae tell us that "the spontaneous healing of local tuberculosis is an everyday affair. A majority of those infected never have the disease, *i.e.*, they recover without symptoms, without the slight lesion having disturbed the health. Many cases of adenitis and disease of the bone or of the joints terminate favorably. The healing of pulmonary tuberculosis is shown clinically by the recovery of patients in whose sputum elastic tissue and bacilli have been found; anatomically, by the presence of lesions in all stages of repair. In the granulation products and associated pneumonia a scar tissue is formed, while the smaller caseous areas become impregnated with lime salts. To such conditions alone should the term 'healing' be applied."

Dunham reports that he has found on section of a large calcified node, a center of caseated material from which he recovered and demonstrated living tubercle bacilli.

Spengler describes the results of a necropsy on a case of healed miliary tuberculosis which closely fits with the roentgen ray appearances under consideration here, with the exception that he did not find the healed tubercle to be calcified. More recently Lorey reports a similar case, although the feature of calcification was not present inasmuch as the entire lung fields cleared completely after a few months, the first plates showing the same distribution as those under consideration here.

H. Gideon Wells, in a personal communication, writes: "I have no doubt whatever that miliary tuberculosis may heal. In fact, I suspect this happens frequently. Miliary tuberculosis ordinarily kills only by producing a meningitis. I see no reason why one might not have quite an extensive miliary tuberculosis without meningeal involvement, in which case there is no obvious reason why it may not heal, but if it does heal no one would ever know it, for miliary lesions may heal with no recognizable scars by which the healed condition might be detected. A calcified tubercle, even, cannot be positively identified as a tuberculous lesion, however certain one may be that it is such. For example, we often find the spleen studded with minute calcified globules, the origin or nature of which cannot possibly be determined."

Miliary tuberculosis results from a spread or dissemination of a primary focus, from which organisms gain entrance to a vein, which in turn is the means of carrying the escaped tubercle bacilli into many of the body organs. In the event that the primary focus breaks down and showers the bacilli into an artery, the disease will be limited to the area of tissue supplied by that vessel, and thus the involvement may include an entire organ or only a small portion of it. Therefore, it is possible to have the entire lung invaded by the bacilli, the showering being equal in all portions; or a small part of the lung, as for instance, one lobe, or even part of a lobe, may be involved. The resulting miliary tubercles pass through the usual changes characteristic of this lesion and the patient usually succumbs in a short time from the overwhelming attack, particularly when of the venous transportation form, when it invades the meninges.

The individual tubercles in this type of lesion remain as single areas of pathology and do not merge or coalesce as they do in the fibrous and caseous forms in which many small tubercles fuse and spread out into the surrounding tissues, thus becoming large areas of degeneration, at times invading an entire lobe. The appearance of caseation necrosis is fairly rapid in a tubercle due to the toxic products of the tubercle bacilli and to the complete absence of blood vessels through the lack of which it receives no nourishment. The

calcification of the tubercle is an end stage of the process and the calcified tubercle is no longer potent as a retarding factor in the well-being of the individual. In fact, it is similar to the clinker of burnt-out coal of the furnace fire, no longer capable of further activity. Thus, one may properly assume a healing, as it were, of those particular foci that are seen, on the roentgen-ray projection, to be calcified.

Occasionally an individual attack by such a shower of tubercle bacilli may, by some peculiarly favorable turn of events, become sufficiently resistive to overcome the barrage: the numerous caseous tubercles undergo a recession, and a healing takes place in which such changes as dense fibrosis—which may become massive in extent—or perhaps calcification, occurs. That this latter sequence occurs (though evidently at rare intervals) is evident from the developments in such cases as are here presented.

In a majority of instances, the paucity of clinical symptoms is surprising. In the phlegmatic individual it is difficult to elicit any history of an acute sickness in the ordinary sense. He is prone to overlook or underestimate the importance of a period in which he did not feel well, his appetite was not up to normal, or he seemed to lack his usual "pep" for a few days or a week or two, and he may have paid no attention to such a physical falling off. Following this uncertain period, he recovers his former more or less normal condition. On the other hand, the high-strung or neurotic type of person most often recalls such a period in which he had to lie down or go to bed for a few days, later getting along all right, often without recourse to the physician. In such cases one is less reluctant to believe that an acute miliary tuberculosis is a possibility. A rise in temperature may not be recognized by the former group, who often have an increase of two or more degrees without realizing it, while the latter invariably know that they have fever. Headache, malaise and the usual accompaniments of temperature increase are a part of the story of the more highly strung person, while the phlegmatic individual invariably fails to note such occurrences.

That an active tuberculosis can be present in the intervening areas is not to be denied, but when these areas which lie between the individual dense shadows under discussion are of normal transparency to the roentgen ray, it is safe to assume this particular tissue to be normal, especially if there be no clinical evidence of a pulmonary disease at the time of the roentgen examination. This situation is one of the chief points of my observation, and is definitely established before the case is regarded as one of healed miliary tuberculosis.

A varying number of these lesions are present in the different cases; in one we find the multiple spots lying so close together that there is little of the lung field that can be visualized, literally thousands of foci being evident; in another case, the foci are so far apart as to throw some doubt on the point of its being properly considered a disseminated miliary tuberculosis. One will recall that the term "miliary" usually refers to the size of the tubercle, and one may have but a very few of such miliary tubercles or, on the other extreme, so many as to startle the observer when he views the case roentgenologically. Here enters the probability of an involution of the majority of the tubercles, a few only undergoing calcification. The individual lesion, however, is in both instances, substantially the same. While it is true that the calcified tubercle is not in itself a positive sign of a preceding active tuberculosis, the greater incidence makes the probability so great as to permit us to assume such to be the case.

Case I. Male, white, aged thirty-six, 5 ft. 7 in. in height, and weighs 145 lbs. He does not look sick, and his general makeup is that of a robust phlegmatic individual. He complains of a moderate cough and raises a small amount of sputum which often shows red streaks. He gives a history of a pulmonary hemorrhage which occurred several years ago, but this was not accompanied by any other symptoms that he noticed. No investigation of the sputum was made at that time. Repeated examinations of recent sputa fail to show any tubercle bacilli. No rise in temperature was noted, but this is the patient's opinion

only, no thermometer being used. His weight has been more or less stationary as far as he knows, but he says he has weighed more and, at times, less than at present. He works out in the open. He appears to be well built and well nourished. Roentgen examination results in the extraordinary finding seen in Figure 1, in which disseminated, multiple, small, dense shadows are evenly distributed in all parts of the lung fields. Viewed stereoscopically, these shadows represent calcified foci in the pulmonary tissues. When an explanation of these most unusual shadows was sought,

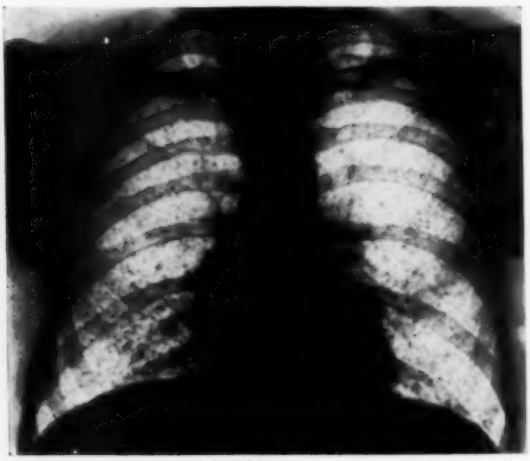

FIG. 1.

the patient was found to have worked for a brief period (three weeks) laying a cement sidewalk. This is the single instance in which he was so occupied, and he never worked in an atmosphere in which he had to inhale quantities of dust of any kind. A silicosis can also be ruled out, inasmuch as he has never been occupied where such material was used. It was thought by one observer interested in the case that the numerous densities represented an inhalation lesion or calcicosis, but this does not seem to be tenable because of the relatively short period of employment (out in the open) as a cement worker. It is highly probable that these unusual shadows represent the sequence of a sudden increase of body resistance to a showering of tubercle bacilli which gained entrance in the arterial trunks supplying the lungs from a broken-down tubercle lying somewhere close to the lumen or in the wall of such a vessel. It is, of course, possible that the patient had a more extensive dissemination, that is, in other organs, pleura, etc., but obviously this cannot be determined by the roentgen examination; it is seen only in the lung because of the favorable contrast of tissue densities which permit the visualization of these very small calcified masses.

CASE II. Male, aged thirty-four, 5 ft. 7½ in. tall, and weighs 115 lbs. He is an automobile mechanic. His complaint sounds more or less like a textbook recitation of the symptoms of pulmonary tuberculosis, but the outward evidences which would confirm his story are not present. He reports a loss of 45 lbs. since 1918. The clinical findings did not indicate a pulmonary disease, being practically negative in auscultation, palpation, sputum, etc. This, however, does not tell us what he may have had in the way of sickness prior to the present time. He says that he has been diagnosed clinically as "tuberculosis." The roentgen findings are as seen in Figure 2, the most striking feature being a dissemination of small, hard-looking, sharply bordered shadows that represent calcified foci in the lung, which are the healed areas of previously caseated tubercles of miliary size. These spots do not lie as close to each other as those found in Case I. This brings up the question of whether a large number of the tubercles in the intervening areas did not undergo a calcification necrosis, as might have been the course in Lorey's case, but did involute and were later absorbed.

CASE III. Male, white, aged twenty-four, single, laborer. He has been up and down in weight, averaging 165 lbs. He is well developed, well nourished, and did not appear to be acutely ill at the time of roentgen examination. He complains of pains in chest as well as in stomach. In May, 1922, he had four hemorrhages from the lungs, occurring at very short intervals, during which he lost a large amount of blood. He had seen a doctor just previous to the occurrence of these hemorrhages, and a temperature of 102° was found. He was instructed to go to bed, but remained around home and did not

go to the hospital or seek further medical advice. He states that in January, 1922, he commenced to have pains in his left chest around the heart, and thought it was heart trouble. In August he complained of some shortness of breath, and was admitted to the hospital, where he was treated for "lung trouble." Microscopic studies revealed repeated positive t.b. sputum. He has had no positive sputum recently. The roentgen findings are as illustrated

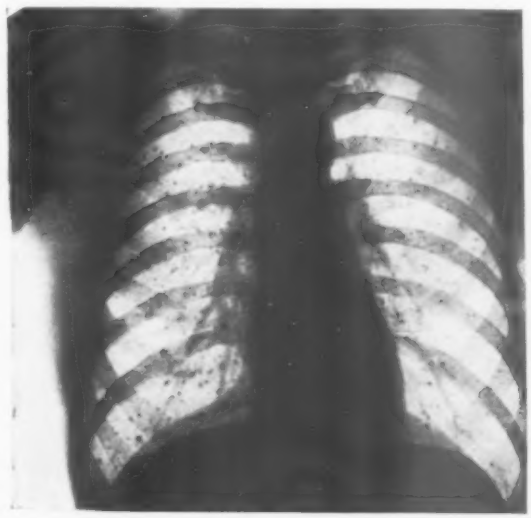

FIG. 2.

in Figure 3, which shows a number of small calcified areas fairly evenly distributed throughout both lung fields. Here again we see the millet-seed-size shadow densities similar to those noted in the preceding cases, though more widely separated, which one has reason to believe represent healed calcified tubercles.

SUMMARY

1. From post-mortem studies reported in the literature, it is evident that at rare intervals a miliary tuberculosis of the lungs will heal. Occasionally this healing seems to be accompanied by a calcification necrosis of the individual tubercles, which calcification remains as sole evidence of the disease.

2. The roentgen findings in such cases are numerous small, shot-like shadows, evenly distributed over both pulmonary fields.

3. The distribution of lesions is characteristic of disseminated tuberculosis of miliary type.

4. Although lacking post-mortem proof, it is highly probably that the 3 cases here reported are to be considered as instances of healed, calcified miliary tuberculosis of the lungs.

FIG. 3.

ABSTRACT OF DISCUSSION

Dr. Blaine's paper was freely discussed. The consensus of opinion was that there is no proof that these lung findings represent healed miliary tuberculosis, but that after all this seems the most reasonable explanation. Several of the members reported cases with roentgen findings closely resembling those seen in Dr. Blaine's cases. Dr. Pendergrass suggested the possibility that the miliary shadows are due to calcium metastasis in the lung and Dr. Martin reported a case in which they were interpreted as calcified areas due to healed trichinosis.

THE VALUE OF THE ROENTGEN RAY IN THE DIAGNOSIS OF ATYPICAL PREGNANCIES, WITH REPORT OF TWO CASES OF ANENCEPHALY DIAGNOSED BEFORE BIRTH*

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THE diagnosis of or confirmation of diagnosis of pregnancy by the roentgenogram is not new. Since 1899, when Mullerheim reported his work, there have been sporadic reports of roentgenographic work done on pregnant patients. Bartholomew places so much dependence on the roentgenogram that he makes it his fourth positive sign of pregnancy. In spite of this, there is still, throughout our very conservative profession, one of whose most conservative members is the obstetrician, a marked hesitancy to submit the pregnant woman to any roentgenographic procedure because of a supposed danger to the fetus. This is a fallacious attitude and is unjustifiable in view of our present technique and experience. From a medicolegal standpoint the roentgenogram is unanswerable in a case of doubtful pregnancy after the fifth month of gestation. Orndoff reports its value along these lines in a private conversation, and Stein and Arens[1] describe a situation which could easily be of legal significance.

With all due respect to the ability of the obstetrician to make and interpret properly the various pelvic measurements, I believe that the addition of good stereoscopic roentgenograms will give him a much better understanding of the relation of the pelvic structures than will measurements alone. This is especially true in cases of contracted pelves and of spinal curvature. Here are shown not only the details of the bony deformities, their relation to each other, possible compensations, etc., but also the actual relative size of the fetal head which must pass through this outlet.

Multiple pregnancies are sometimes diagnosed—frequently only suspected—and often have been completely overlooked before labor. The usual suspicion is an hydramnios with a single pregnancy. One of my cases referred as hydramnios, which was present, showed an unsuspected twin pregnancy. It is of rather vital importance to know the position of the fetal parts, especially the heads, in these multiple pregnancies, to offset troubles at delivery. The life of one of the babies may have to be sacrificed if there arises a condition of locking of the heads, etc., which occurs frequently enough to justify several pages in all books on obstetrics. Forewarned is forearmed; hence the value of the roentgenogram. In marked toxemia of pregnancy, a roentgenogram will be of extreme value even in the negative sense—that is, to show that the fetus is apparently normal; but its greatest value will be to point out abnormalities and thus allow the obstetrician to terminate a dangerous situation. One of my cases of anencephaly was sent in to determine whether to fight the toxemia or to terminate the pregnancy.

A roentgenogram should always be taken in a case where Cesarean section is contemplated because of fetal or maternal dystrophies or disproportions—emergency operations in eclampsia alone being excepted—and it is advisable here if time permits. The roentgenographic procedures require a comparatively short time. The embarrassment of delivery by Cesarean section of a monster, an already dead fetus or an extremely small child might be prevented.

The size of the fetus can be fairly accurately determined by the roentgenogram and an approximation of the age can be reached. In spite of the excellent work of Hess, I feel that we are not yet in a position to state the exact age of the fetus in utero; there are too many of the finer details of the osseous structure lost

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

or blurred by distance from the film, movement and that multitude of details which constantly arise. The position and change of position of the fetus can be determined accurately. I have seen a breech presentation at the eighth month become a cephalic presentation two weeks later. A foot or transverse presentation can be shown with certainty and if a version is contemplated, the probable modus operandi can be determined before labor. Spalding[2] has given to the profession one of the very few pathognomonic signs of intrauterine fetal death, the overlapping of the cranial bones before labor. Two of my cases have given the impression of a shrinkage of the cranial contents with a flattening of the normal transparietal arch or dome without definite overlapping of the bones, a sort of flattening of the head; a condition which I believe precedes the overlapping of the bones. Death of the fetus had been suspected only a few days in these cases and I am confident that *later* roentgenograms would have shown the overlapping. These patients were delivered of dead fetuses.

Case,[3] in 1917, reports the first and only case of anencephaly roentgenologically diagnosed that I have been able to find in a review of the literature at my disposal. He says: "A careful search of the literature has failed to disclose the report of a similar instance." The pathologist's report and the roentgen-ray findings in my cases correspond in almost every detail with the case reported by him.

Anencephaly, or better craniorrhachischisis, is one of the most frequent of all fetal monstrosities. Kirkness in 1911, reported one case of anencephaly in every 900 deliveries in a series of 11,521 births in the Rotunda Hospital. Of the several theories of the etiology of this condition three seem to have most support: (1) Early hydrocephalus of the fetus with rupture and later atrophy of the cranial membranes (Ahlfeld as quoted by Carey)[4]; (2) Changes or toxis in the amniotic fluid (Webber-Hertwig); (3) Faulty implantation of the ovum due to changes in the endometrium (Mall-White).[5] I will not enter into a discussion of these theories, nor will I theorize on the other abnormalities which I am convinced can be as easily shown on the roentgenogram.

It has been my privilege to see 2 unsuspected cases of this abnormality and to make a correct diagnosis before delivery—in fact, to have the pregnancies terminated to spare the mother the many trials of continuing pregnancy and the chagrin of delivering a monster at term.

Case I. Female, white, aged twenty-one, seen Oct. 10, 1921, having been married seven months. Family history negative. Menses began at fourteen, always irregular and painful; last menstruation May 5. Some nausea for four months. Movements felt Oct. 10. Examination shows uterus of about size of four months' pregnancy. Blood pressure 118 over 80; Wassermann negative; general condition excellent. Patient was seen each month, nothing abnormal being noticed until Jan. 10, when there was marked hydramnios. The presenting part could not be determined. Jan. 14, patient referred to Roentgen-ray Department to determine if possible the cause of hydramnios and to ascertain the presenting part. Roentgen-ray report Feb. 6: Film shows no fetal cranial bones, vertebrae poorly developed, length of spinal column less than normal, ribs demonstrable with bones of face close to thorax; bones of extremities appear normal. Roentgen-ray findings indicate an anencephaly. Feb. 14, patient states she has felt no movements for four days. A second roentgen examination shows no change from previous report. Feb. 18, labor induced. Fetus delivered normally, weight 5 lbs. Pathologist's report:

"The specimen consists of a female fetus, $33\frac{5}{10}$ cm. long. The surface reddened everywhere, and the superficial layers of epithelium partially desquamated. The head is imperfectly formed. It begins to slope backward immediately above the eyes and from the upper borders of the ears. Just a fringe around the periphery is hair-covered. The remaining surface is red and smooth except for an irregular mass about 3.5 cm. in diameter which lies just above the widely open vertebral processes. The vertebrae have failed to close for a distance of 10 cm. from

the highest point of the head. This is approximately half the total length of the vertebral column.

Pathological Diagnosis: Craniorrhachischisis of fetus of late seventh month."

CASE II. Female, married, first seen July 8, 1922, aged twenty-eight. Family and personal history negative; miscarriage at two and one-half months in 1921; no other pregnancy until present one. Last menses May 7, 1922. Quickening Oct. 5th; expected confinement Feb. 14, 1923. Physical condition good excepting pyorrhea. Blood pressure 110 over 80. Progressed all right until Dec. 14, when albumen and casts appeared in urine; blood pressure 140 over 110. From this time until delivery, in spite of most careful attention, blood pressure remained high and urine continued to show albumen and casts. At eighth month the uterus was not so large as it should have been. Because of this and the toxemia patient was referred to the Roentgen-ray Department. Roentgen-ray report Jan. 19, 1923: Films show anencephaly with marked shortening of the vertebral column, small thorax, rather large femurs and tibiae. Delivered Jan. 20, still-born; non-instrumental labor. True "frog fetus"; almost identical with description of previous case.

SUMMARY AND CONCLUSIONS

1. Roentgenograms of pregnant uterus are apparently without danger to either fetus or mother.

2. Roentgenograms should be made before finally determining on Cesarean section.

3. Roentgenograms are of distinct value in medicolegal situations.

4. Every pregnant woman showing anything abnormal should have roentgenograms made. They give valuable information even though it be in the negative sense.

5. Fetal abnormalities can be more accurately determined by roentgenograms than by any other method.

Note: I wish to express my sincere thanks to Drs. Bourland, Gordon and Carr of the Medical and Surgical Clinic for their cooperation in this work, and for their permission to report these cases.

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STATISTICS AND TECHNIQUE IN THE TREATMENT OF SUPERFICIAL MALIGNANCY WITH RADIUM, ROENTGEN RAYS AND ELECTROTHERMIC COAGULATION.*

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I BELIEVE that every case of localized malignancy of the skin will recover if treated thoroughly and skilfully with radium, roentgen rays, and electrothermic coagulation. Also many of the cases that are just beginning to show metastasis into the immediate neighborhood can be cured by similar treatment. The results of treatment in cases showing definite metastasis often at considerable distances from the primary lesions, together with those known as hopeless from every standpoint of the older method of treatment while most encouraging from the palliative standpoint, will not be productive of many permanent cures.

FIG. 1. Epithelioma before treatment.

FIG. 2. Same case as in Figure 1, after treatment with electrothermic coagulation and radiation.

Pathologically, malignancy of the skin is classified under three great groups: (1) Basal cell epitheliomata, (2) squamous-cell epitheliomata, and (3) sarcomata of the fibroid and melanotic types. Basal-cell epitheliomata are easily eradicated with any combination of the above physical agents. Squamous-cell epitheliomata must be treated early with thoroughness and skill because of their rapid growth with metastasis. One must irradiate thoroughly the actually diseased area together with all the lymphatic chains draining it. If efficiently treated before there is metastasis, fibrosarcomata can be cured. Here too the lymphatics and blood-vessels draining the diseased area should be closed with radiation treatment. Owing to the extreme malignancy of melanotic sarcomata, with their rapid growth and early systemic metastasis, treatment is seldom followed by more than slight palliation. The time to treat this disease is before it becomes sarcomatous, i.e., the melanomata. I have treated a number of these melanomata and to date have had no recurrences or deaths from melanotic sarcomata following such treatment. Therefore, I cannot too strongly

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

advocate the removal of the premelanotic sarcomatous lesions, the melanomata, particularly if they are located upon parts subject to constant irritation, or if they are prone to develop ugly symptoms such as sudden, rapid growth, bleeding upon slight injury, sticking to clothing, scaling, etc.

Generally I treat these skin malignancies first with a complete destruction of the lesion by means of electrothermic coagulation. This is a surgical procedure and consists of the use of the high-frequency current passed through the tissues with sufficient intensity to coagulate them. The coagulation is due to the generation of heat within the tissue itself while the applicator remains cold at all times. For the smaller lesions the Ouidin current is used, while the larger and more extensive lesions require the d'Arsonval current. If the latter is used, a large pad or metal electrode is connected with one pole of the machine, the pad being placed usually under the buttocks of the patient. To the other side of the machine the destructive electrode which is usually a point, is connected. The point is then held in contact with the tissue to be destroyed and the current is turned on. The amount of current necessary must be learned by actual experience since the milliammeter is not a reliable guide. The coagulation at one point is completed when the tissue is dead white and the current should be switched off just before sparking begins. The coagulation should begin in the healthy tissue well beyond the edge of the actually diseased area. This produces an obliteration of the blood and lymph channels which tends to prevent metastasis. After this coagulation wall has surrounded the lesion completely, the diseased tissue itself is destroyed and can then be removed with a curette or scissors, the operator being most careful that he does not get into parts beyond the coagulated tissues.

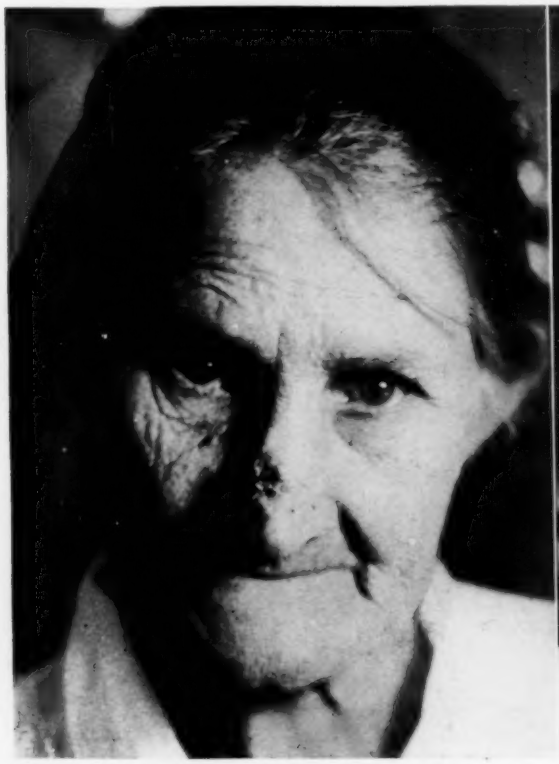

FIG. 3. Epithelioma with deep destruction before treatment.

FIG. 4. Same case as in Figure 3, side view.

Basal-cell epitheliomata are irradiated immediately following coagulation with the roentgen rays. The radiation field is so mapped out that the rays extend well beyond the edges of diseased tissue into the healthy tissues. The factors for treatment are: 4 ma. 134,000 volts; 6 mm. Al. filter or 0.25 mm. Cu. plus 2 mm. Al.; 8 in., 12 in., 16 in. and 20 in. focal distances are used; 170 electrostatic units dosage. An electrostatic unit is a quantity of units of charge in the period of time. Filtration and focus-skin distances are varied as already described, the lighter filtration and shorter focus-skin distances being used for the most superficial cases, the heavier filtration and longer focal distances being used for cases with deep tissue involvement.

Immediately following coagulation, squamous-cell epitheliomata are treated similarly with the roentgen rays, using the

FIG. 5. Same case as in Figure 3, after treatment with electrothermic coagulation and radiation.

FIG. 6. Same case as in Figure 3, showing result, side view.

electricity sufficient to raise a sphere of a radius of 1 cm. to the unit of potential, i.e., 300 volts. One electrostatic unit of radiation is a quantity of radiation sufficient to ionize each cubic centimeter of air in the radiation beam so that it will allow the passage of one electrostatic unit of current. One electrostatic unit of current equals one electrostatic unit of charge per second. The number of electrostatic units of current multiplied by the number of seconds equals the number of electrostatic

heaviest filter and either the 16 or the 20 in. focus-skin distance already described, with 200 electrostatic units dosage. In addition, whether or not there is already involvement of lymphatics draining the diseased area, all the lymphatics are thoroughly irradiated with the roentgen rays. If the lymphatics are not involved the 0.25 Cu. plus 2 mm. Al. filter is used with the 12 or the 16 in. focus-skin distance, dosage 170 electrostatic units. If the lymphatics draining the primary site of the disease show any sign of

FIG. 7. Large epithelioma of dorsum of the hand.

FIG. 8. Same case as in Figure 7, after treatment with electrothermic coagulation and radiation.

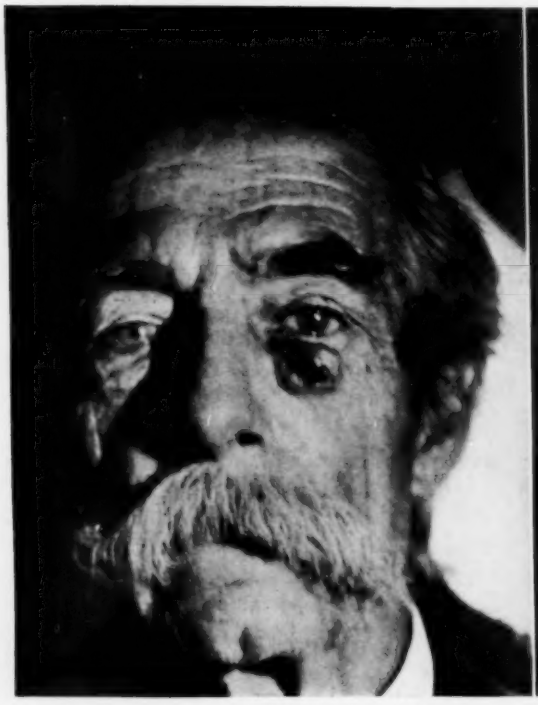

FIG. 9. Epithelioma entire left lower lid, with destruction.

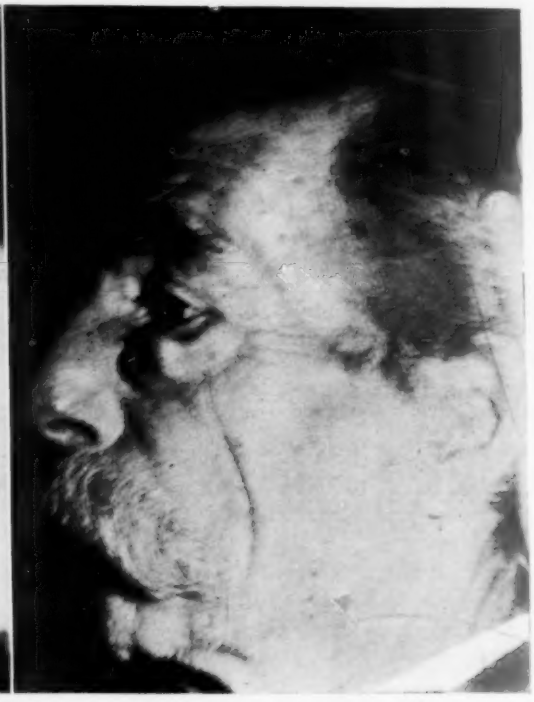

FIG. 10. Same case as in Figure 9, side view, showing depth of destruction.

involvement, they are treated thoroughly with rays produced at the maximum voltages obtainable. The factors are 4 ma.; 220,000 volts; 0.6 mm. Cu., plus 1 mm. Al., plus ¼ in. sole-leather filter; 20 in. focus-skin distance; 200 electrostatic units dosage Radium in the form of 5 or 10 mgm. needles is also added to the treatment in cases showing metastasis. The needles are buried deeply into the metastatic nodule or nodules 1 cm. apart if the 5 mgm. needles are used, 2 cm. if the 10 mgm. needles are used. They are left in place sixteen hours.

Fortunately sarcomata of the skin are much less common than is either of the above types of epitheliomata. Cases of fibrosarcomata are treated as already outlined under squamous-cell epitheliomata. I have tried many different techniques in the treatment of melanotic sarcoma, with uniform failures. As already mentioned, the time to treat melanotic sarcomata, is before the melanomata have undergone sarçomatous degeneration. Melanomata are destroyed thoroughly at one sitting by means of coagulation, which is followed by radiation, using the technique in general as described under basal-cell epitheliomata. However, particularly about the eye, it is often satisfactory to substitute a radium pack for the roentgen rays. This treatment is followed by little or no scar, and to date I have had no recurrences or sarcomatous degenerations.

FIG. 11. Same case as in Figure 9, after treatment with electrothermic coagulation and radiation.

FIG. 12. Same case as in Figure 9, side view, after treatment.

In the treatment of these lesions it is of great importance that the treatment be completed as nearly as possible at one sitting. Lately I have had referred a number of cases that have had several excisions or treatments by various caustics or by repeated exposures to radium or the roentgen rays. These cases are most difficult to cure. Treatment not completed in approximately one sitting is often followed by an increase in resistance of the cells, i.e., they become equal in resistance

to the normal cells, or actually have a greater resistance than the normal cells. They are called "adult cells." Therefore let us carefully learn the method of treatment of these lesions with the physical agents at our command. Particularly must we know the value of each roentgen apparatus, which is obtained by actual measurements of the radiation values with the iontoquantimeter. In no other way can the correct radiation doses be given.

BASAL-CELL EPITHELIOMATA

	No. of Cases	Clinical Cures 1–5 Yr.	Failures	Per Cent of Successes
Small	101	101	0	100
Large-deep	44	41	3	90

SQUAMOUS-CELL EPITHELIOMATA

	No. of Cases	Clinical Cures 1–5 Yr.	Failures	Per Cent of Successes
Localized	22	22	0	100
Borderline	6	5	1	83
Widespread metastasis.	11	2	9	18
Recurrent	12	5	7	41

SARCOMATA

	No. of Cases	Clinical Cures 1–3 Yr.	Failures	Per Cent of Successes
Melanotic sarcomata	8	0	8	0
Fibrosarcomata (localized)	5	5	0	100
Fibrosarcomata (with metastasis)	9	0	9	0

MELANOMATA

No. of Cases	Clinical Cures	Failures	Per Cent of Successes
38	38	0	100

These 38 cases represent 87 melanomata

CONCLUSIONS

1. If treated early and correctly radiation therapy plus electrothermic coagulation can be expected to cure approximately 100 per cent of skin malignancies, with the exception of melanotic sarcomata.

2. The benign forerunner of melanotic sarcoma, the melanoma, when treated correctly with the above physical agents, should produce equally satisfactory results.

3. The results in the treatment of melanotic sarcomata are uniformly bad.

SURGICAL AND ROENTGEN TREATMENT OF CARCINOMA OF THE RECTUM*

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FOR more than thirty years surgery has sought, by means of a constantly improving technique, to solve the problem of the radical removal of carcinoma of the rectum. True, it has succeeded in reducing the primary mortality to a minimum; yet the statistics show only a small percentage of lasting cures. When one considers the fact that inoperable cases make up approximately 50 per cent of all carcinomata of the rectum, one sees that surgery holds out no great hope for cure of this disease. The best statistics show, after three years, a cure of only 10–12 per cent. One is therefore all the more inclined to place his hope in radiation therapy. The results obtained by Kroenig and Gauss, Seitz and Wintz, and others in the treatment of cancer of the uterus, invite an analogous conclusion as to the neighboring organ. Lamentably, this is not confirmed. The differences in situation, extent, in function of the lymphatic vessels concerned in the two cases, as well as in the sensitivity of their tumors to radiation, are too great to permit one to expect similar results. To-day we must recognize that pure radiation therapy still lags behind surgery in respect to lasting cure of carcinomata of the rectum. For one thing, radiation therapy has been limited to inoperable cases, except for such operable cases as demanded, for one reason or another, bloodless treatment. If all cases were submitted to radiation treatment only, as carcinomata of the uterus are in some clinics, we would then have a more favorable estimate of its worth. Furthermore, our radiation technique is becoming more and more satisfactory.

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

It was a natural procedure to combine the surgical and radiation methods of treatment. As a matter of fact, the results which have been published—I refer especially to the recent work on carcinoma of the rectum by my teachers Schmieden and Holfelder, by A. W. Fischer, J. Thompson Stevens, and Bowing and Anderson—indicate that this is the path to follow. *Above all, the fruitful combination of both methods of treatment demands the closest cooperation between surgeon and radiotherapist.* Before treatment is undertaken in any case, both must decide upon the best way. The operation is evaluated no longer from the purely surgical standpoint, but

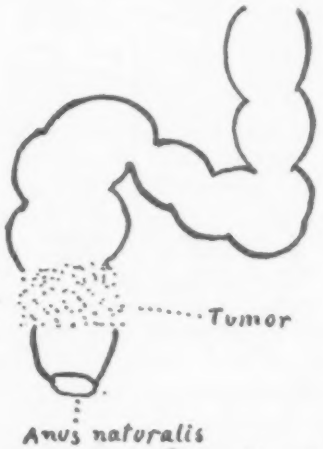

FIG. 1. Schematic drawing of the position of a carcinoma recti.

it must be decided in what way the operation and the radiation treatment can best supplement each other.

From this standpoint Schmieden and Fischer have adopted a method in surgery of the rectum which, while it spares the patient, has the advantage that it is radical and allows the closest cooperation with the roentgen therapeutist.

The treatment of every rectal carcinoma in our clinic begins with the formation of an artificial anus to put at rest the diseased gut, whether or not the patient suffers from manifestations of stenosis, and whether or not the case is operable. Between the navel and the symphysis the abdomen is opened so widely that the operator can easily determine the size and extent of the tumor and its metastasis in the neighborhood, and in the liver. *The principal assistant at the operation is a roentgenologist.* With his measuring instruments he determines the exact extent and situation of the tumor with respect to fixed points of the body, so that he can subsequently work out his radiation plan in transverse and longitudinal charts. After a method devised by Gaudier, the anal limb of the sigmoid loop is freed from its mesentery (Figs. 1 and 2) the superior hemorrhoidal artery being preserved. The sigmoid loop is then cut across at its apex. The proximal end is stitched to the abdominal wall and the

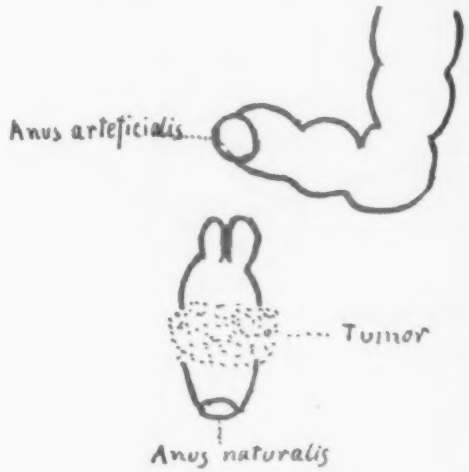

FIG. 2. The rectum is put out of use by a colostomy at the sigma.

anal end is invaginated and buried in the pelvis. Thus the patient is given a small abdominal anus, which, because of its short sigmoid mesentery, cannot prolapse, and which he can control better than a sacral anus.

We lay great stress upon the irrigation of the now idle portion of the gut, a procedure which is begun a few days after the operation. It brings about a decrease in the inflammatory manifestations, which, extending from the portion ulcerated by the carcinoma, make the latter appear to be of a size greater than it really is. Now, since the ulcer is spared the passage of the fecal masses which have kept it constantly irritated, and since it is cleansed by daily washing, the inflammatory manifestations subside and the tumor becomes smaller.

Some border-line cases under this treatment may come to appear operable.

Ten to fourteen days after the formation of the colostomy the carcinoma itself is attacked by roentgen treatment. Such treatment requires the same pains and care as an operation. One may speak of it as a roentgen operation. Under no circumstances may it be left to an unschooled physician, or to roentgen assistants. The most important preparation for the treatment is the formation of a *plan* of treatment. Available for this, together with the examination findings and the roentgenograms, are the topographic notes made at the operation, which outline the territory

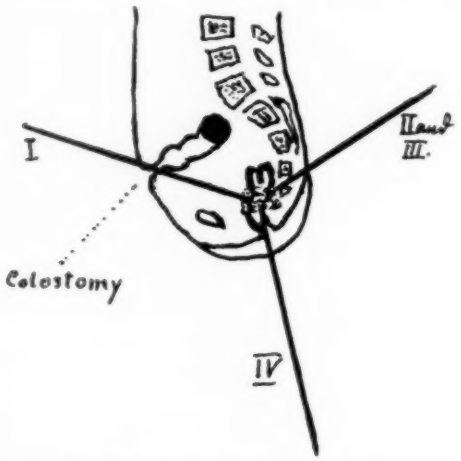

FIG. 3. Direction of the central rays in a longitudinal section. I, abdominal field. II and III, posterior fields (appear as one line, as projected at each other). IV, perineal field.

to be irradiated. The principal object is to direct the bundles of rays to the tumor and its bordering lymphatics so that a dose is delivered of such magnitude as to bring about a shrinkage of the tumor. Here our corner stone is the carcinoma dose of Seitz and Wintz and the carcinoma minimum dose of Juengling. To obtain as hard rays as possible only one of our modern high-voltage equipments is used. With the aid of the Holfelder field selector are determined the number and size of the fields, the focus-skin-distance, the direction of the central rays with respect to the body-axis, and the ray dose for all fields. We lay great emphasis upon having only the tumor and its lymphatics in the cross-fire of the rays which here unite to a homogeneous intensity. By this means we spare the sound tissue as far as possible and avoid an excess of rays acting upon the intervening blood and tissue, which could not be accomplished with the larger field method. Usually four to five fields are treated. Each of them has to have a percentile depth dose of 30–35 per cent under 10 cm. water. Two are posterior fields treated obliquely from the outer border and above, approximately in the posterior axillary line. When there is one abdominal field, it is treated in the midline, obliquely from above (Figs. 3 and 4). When there are two abdominal fields, as we use them in stout patients, they are

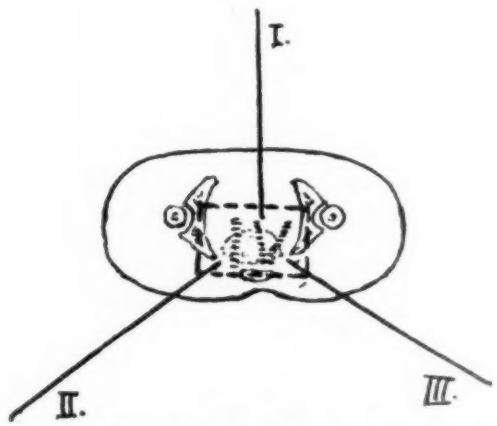

FIG. 4. Direction of the central rays in a cross section. I, abdominal field. II and III, posterior fields. The inclination to the horizontal plane of I, II, and III, as shown in Figure 3 cannot be expressed in this drawing. IV (hached), perineal field (crosses this section vertically).

treated in approximately the anterior axillary line obliquely from the outer border and from above.The fifth field is perineal, the patient in the lateral decubitus with legs drawn up, the rays in the body axis. This field receives only 80 per cent of the erythema dose, in deference to the sensitivity of the mucous membrane of the anus and vulva, while the other fields usually receive the full dose. To shorten the period of treatment we irradiate two sides simultaneously, if possible.

This plan of radiation, after Holfelder, has shown itself to be the best. Naturally there are no hard and fast rules, as the details must vary from patient to patient;

but they are rapidly and easily worked out by the field selector already mentioned.

It is possible, by exact determination of the fields, to deliver 100–110 per cent of the erythema dose homogeneously over the whole tumor field.

One of the consequences of the radiation of the abdomen is irritation of the mucous membrane of the bowel. As the skin indicates the different grades of ray effect, so the intestinal mucous membrane is an indicator for the effect in the deep tissues. The first stage is swelling and slight erythema, evidenced by profuse discharge of mucus. This arises from a dose of 80–90 per cent of the erythema skin-dose. The next stage is that of frank inflammation, with fibrin formation, extensive cell desquamation and bloody mucous discharges. This results from 110–120 per cent of the erythema dose. Ulceration appears after about 130 per cent, involving the serosa as a rule. This is the result of either a generalized overdose or a sign of unhomogeneous radiation. In one case of a local overdosage produced by crossing two abdominal fields too much, the patient fell sick with symptoms of a subacute ileus. On opening his abdomen we found a loop of small intestine fixed in the lower pelvis. The loop appeared quite white and showed a sclerosis and an almost complete stenosis of the lumen. While the first of the manifestations just described usually clears up in one to three weeks, the ulcer takes longer to heal. Complications, varying from simple mucous membrane ulcer to deep necrosis of the bowel with fatal outcome, are described by Béclere, B. Fischer and others. The animal experiments of Denis, Martin and Aldrich, of Warren and Whipple, of Dragstedt, Moorhead and Burcky and of Martin and Rogers have thrown much light upon the roentgen biology of the intestines. Wintz states that the small intestines will tolerate 30 per cent more than the large. It has been our experience that the bowel relieved from its function will tolerate higher dosage, and that it also recovers much more quickly from radiation than the bowel through which fecal masses are passing and causing irritation. This is a further argument in favor of an artificial anus.

In almost all cases we succeed in shrinking the carcinomatous tissue. In this way the severity of the subsequent radical operation is diminished in the operable cases, and the work of the surgeon is made less difficult. In no case have we observed tissue changes resulting from the irradiation that were unfavorable for the following radical operation. Sometimes after the radiation we find small ulcers of the mucous membrane of the colostomy. To avoid this, we cover the colostomy with a piece of leaded rubber. Of the inoperable tumors a number become mobile and definable and can be transferred to the list of operable cases. The cases with large liver metastases remain behind with those which, in consequence of great extension, remain inoperable despite repeated radiation.

All other tumors that now appear operable are subjected to radical operation. As in those described above, here also *the assistance of a roentgenologist is very important.*

Whether the tumor is only a small nodule at the beginning of its development or an extensive growth, it is always subjected to the most radical operative measures, which take place four weeks after the irradiation. Avoiding a second laparotomy Schmieden and Fischer chisel off the coccyx and, from the posterior approach, remove the portion of the bowel that the previous operation has rendered idle. This is easily done after ligation of the superior hemorrhoidal artery. The procedure is perfectly aseptic, and the whole lymph tract and the natural anus are removed.

We have such confidence in the value of the combined method that we have shifted the boundary between operable and inoperable cases far to the inoperable side. We do not exclude cases with small metastases in the liver, or cases in which the tumor has spread into the neighboring organs, if there is any chance of removing the primary diseased region. After the primary tumor is made harmless the metastases react much better to radiation, especially in cancer of the rectum. It has been proved many times that even in cases with recidivations roentgen treat-

ment is of particular value. In 3 cases recurrences in the sacral scar, which were completely inoperable, disappeared after radiation and did not return.

Six weeks after the wound has healed, each patient receives an after-radiation, even when the tumor, so far as we know, has been radically removed. We hope thereby to render harmless the microscopical carcinomatous nests that may have been left behind, and reduce the recidivation rate.

We have learned not to shrink from undertaking this combined therapy in even the most hopeless cases, since such cases often give astonishingly good results. Metastases in the liver and bones react well to radiation. Even though we are not in a position to cure many cases, still the roentgen radiation gives the cachectic patient, through temporary inactivation of the tumor, a new lease on life. Thus we have restored completely inoperable cases, with great liver metastases, to freedom from pain and complaints for an average of almost two years, and have rendered them able to work again for one year. Of the inoperable tumors, each one that is rendered operable by means of radiation is a great gain.

Statistics made from Schmieden's clinic at Frankfurt on Main by Holfelder and the writer, in 1919–1921, show 51 cases with cancer of the rectum treated by the combined method, the diagnosis having been proved microscopically. We treated every case, not one being refused as hopeless. Twenty-nine, or 57 per cent of them, were operable; the other 22, or 43 per cent, were inoperable. Of these 22 inoperable cases, 5 cases, or 23 per cent, have become operable by means of radiation. Of the 57 cases, 2 died as a result of the operation, and 32 died of cancer within an average of two and one-half years. Fifteen cases, or 29.5 per cent show a permanent cure after two and one-half years; 2 others show improvement.

Although the number of our cases is too small and the time of observation is too short, we find a great difference between the results of the purely surgical treatment with 10 to 12 per cent cures after three years and the combined method with 29.5 per cent after two and one-half years. But besides the statistics, we have acquired the unqualified feeling that our results have been considerably bettered as regards cures and recurrences, and even temporary improvements, so that we feel entitled to recommend the combined method of surgery and roentgen treatment. The only disadvantage of our method may be seen in the permanent abdominal anus, for we must reckon with it as a great possibility of recidivations. However, the patients quickly become accustomed to the artificial anus, and with suitable diet and a good bandage they are able to conceal their condition much better than with a sacral anus.

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DISCUSSION

Dr. Martin, Dallas, Texas. I would like to ask Dr. May to give us his technique for applying homogeneous radiation to the pelvis when there are metastases in the groins from cancer of the rectum. Such metastases are not uncommon.

I would also like to ask him whether he has ever seen a carcinoma of the rectum disappear when no more than 110 per cent of an erythema dose was applied to the tumor. As I have seen carcinoma of the rectum it has seemed a most resistant form of cancer, and I have been led to doubt the efficacy of 110 per cent of an erythema dose as a curative measure. If large doses are used, we are endangering the mucosae of both the bladder and the rectum. Bladder injuries often do not produce symptoms for a long time after the radiation is administered.

Dr. G. E. Pfahler, Philadelphia. I would just like to ask how soon after this radiation treatment of the rectum is this resection done? And secondly, I would like to ask just what the

results have been in the treatment of metastases to the liver; how long the patient lived afterwards, whether the evidences of the carcinoma had disappeared, and what was the general health of the patient afterwards.

DR. MAY, closing. To answer Dr. Pfahler: we resect the tumor four to six weeks after treatment in operable cases. In inoperable cases we treat the tumor with roentgen rays until it becomes operable. Cases which have advanced too far and cannot be brought back to operable conditions, should be treated as long as we think necessary to inactivate the growth and to give the patient relief from pain and discomfort.

DR. PFAHLER. What about the liver?

DR. MAY. Metastases in the liver react well. Small metastases will disappear completely, larger ones can be controlled for a long time. If one does not radiate the whole liver in cases of metastases, but only the left lobe, for instance, where they mostly appear first, one can reckon, that in other parts of the organ hidden metastases start growing and impair the result. Therefore we made it a rule to treat the whole liver homogeneously with 110 per cent of the erythema dose. This seems to be difficult, but is not, when treated from three directions, one from the front, one from the side and the third field from the back, each in an angle of approximately 120 to the others. We have to use rays of high quality to obtain a high percentile depth dose. The liver can stand such radiation very well. We never saw any bad effects, such as atrophy.

(In reply to questions by Dr. Pfahler, Dr. May stated that he had treated 3 cases with large metastases in the liver and that they were free from pain and distress for two years, and had been able to work for a year; that they had all died at the end of three years and no autopsy could be made.)

To answer Dr. Martin: we give 110 per cent of the erythema dose on the tumor. You will get results if you distribute that dose homogeneously over the whole tumor and its lymphatic system. The danger lies in treating the patient with an arrangement of fields which does not bring about homogeneous action on the tumor: for instance, one place may receive 130 to 140 per cent and another 80 to 90 per cent. The main thing is to irradiate the patient homogeneously and to treat only the tumor and its lymphatic system, which cannot be done by using, for instance, two large fields, from the front and the back only. It is very important to avoid irradiating the healthy tissue as much as possible. Since we have used this method, our patients have suffered far less with roentgen sickness and have recovered more quickly.

The mucosa of the bladder is very sensitive to intensive radiation. Patients usually must urinate oftener after such treatment because of the irritation of the mucosa. When treating the bladder homogeneously one never sees an ulcer. Before and during the treatment we summon our patients to empty their bladder, and so we avoid an excessive irritation of the mucosa by the secondary rays arising from the urine.

DR. MARTIN. What about the groin metastases?

DR. MAY. We treat these metastases according to the case. If we cannot include the treatment of the groin with that of the primary tumor, we separate the treatments. We would then give to the groin one field with a large focus-skin distance from the front, which gives us a high percentile depth dose, or we give three fields in an angle of 120° so that the groin metastases receive 110 per cent.

DR. MARTIN. Wouldn't that complicate your depth dose? That is what I am trying to get at. Wouldn't that give too much trouble in the region of the original tumor?

DR. MAY. If it is possible to treat the groin metastases and the primary tumor at one time, without exposing too much of the healthy tissue to the rays, we arrange the plan of treatment from the beginning so that both places receive 110 per cent of the skin erythema dose. If the metastases are too far away to do so, we have to make out a separate plan. But if this plan would strike the plan of the primary tumor, as crossing of fields of the two plans would cause injuries, we must wait with the treatment of the metastases for six to eight weeks. That can be done without any harm, as Baensch has shown in carcinoma of the breast. After elimination of the primary tumor the metastases diminished without having been treated. If the two plans do not come into collision, they may follow each other within a short interval, as they do, for example, in treating a case of carcinoma of the rectum and its metastases in the liver.

THE ROENTGEN-RAY TREATMENT OF FIBROIDS OF THE UTERUS AND OF MENORRHAGIA AND METRORRHAGIA NOT DUE TO MALIGNANCY*

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THE following observations are based on the treatment of more than 500 cases of fibroids of the uterus and uterine bleeding not due to malignancy, during the past nine years. About 400 of these cases were treated in my own laboratory, the remainder being hospital cases.

E. C. Titus, Pfahler, Sterne and Case were among the pioneers in this country in radiation therapy of nonmalignant gynecological conditions. From occasional reports of a limited number of cases there has grown up an extensive literature on this subject, especially since the introduction of radium. Sufficient time has elapsed, and the number of cases has grown so large, that it should be possible to determine with some precision the indications, contraindications, and results to be expected in this group of cases.

Cases in which this form of therapy is indicated are as follows:

(1) Fibroid tumors of the uterus, except the pedunculated submucous type, or those showing degeneration.

(2) Functional menorrhagia and metrorrhagia of adolescence.

(3) Menorrhagia and metrorrhagia without evidence of gross pathology and most commonly observed in the fourth decade.

(4) Menorrhagia and metrorrhagia due to metritis or endometritis of hypertrophic or polypoid nature.

A contraindication for this treatment is infection, active or latent, in the pelvis. An old quiescent infection may be converted into an active process by radiation therapy. When there is some complicating lesion requiring surgery for relief, this form of treatment should be used only as an adjuvant, for instance, to check hemorrhage.

From the foregoing observations it should be realized that a complete pelvic examination should be made by a competent diagnostician before instituting this treatment. The most favorable time for treatment is soon after a menstrual period. The bowels should be cleared, and the patient should be on a light diet before and after the treatment. There should be no metallic salts in the gastrointestinal tract. The bladder should be emptied before beginning treatment.

Up to two years ago the technique consisted of treating through a number of small areas after the cross-fire method. Treatment was given through six areas, 2½ in. square over the lower abdomen, the rays being directed through each area toward the uterus and ovaries. The factors were: spark gap, 9 in.; 5 ma.; distance, 9 in.; filter, 4 mm. Al.; 6 min. over each area. This was repeated every four weeks until the desired result was obtained. Where there was a large fibroid present, the areas were enlarged so as to include the entire tumor in the combined areas. About two years ago a new technique was developed which has been constantly used since that time. Instead of using multiple portals the treatment is given through a single large one. Where there is a large tumor present, the portal is sufficiently large to include the entire tumor. In the ordinary cases, without a large tumor, the portal is 10 by 15 cm., the long diameter being transverse to the vertical axis. The lower margin of the opening is level with the top of the symphysis. The factors are: 9 in. spark gap, 125 kv.; 5 ma; distance 37½ cm. (15 in.); filter, ¼ mm. cu. and 1 mm. Al.; time, one hour. The copper filters used were made up as ¼ mm., but actual measurement by micrometer shows them to be .275 mm. In addition to the filter mentioned above there is some slight additional material consisting of pads made up of eight sheets of cotton wadding

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

in the form of small quilts. These pads I have used for years under the lead protection used on patients. This eliminates static, and patients are more comfortable than with lead in direct contact with the skin. About 150 cases have been treated with this technique. This amount of treatment rarely causes a reaction in the skin, and if so, it is very slight. When it is desirable to induce the menopause, this treatment is repeated, after a lapse of two or three days, through the posterior pelvic region. In patients over forty, two hours of this treatment given as indicated above will induce the menopause.

In patients under forty suffering from excessive flow, and in whom it is not necessary or desirable to induce the menopause, a single treatment is given and repeated in four weeks if necessary. A certain percentage of these cases shows improvement after a single treatment, whereas others may flow more profusely at the next menstrual period. Usually after the second treatment the flow diminishes and menstruation becomes normal or somewhat less than normal. If the result desired is not obtained, a third treatment is given about two months after the second; that is, at the end of the second menstrual period following the preceding treatment.

A fibroid uterus the size of a five-months' pregnancy will not be palpable above the symphysis and will be but little above normal size after four treatments. Larger tumors extending to the navel or above gradually diminish in size, the full effect of the treatment not being realized in less than one year.

Radiation therapy controls hemorrhage in these cases through its effect on the ovaries and on the development of the Graafian follicles. There is still some diversity of opinion as to whether the reduction in size of a fibroid uterus is due to the direct action of the rays on the tumor or whether it is secondary to the effect on the ovaries, it having been known for a long time that these tumors do diminish in size after the menopause. From my own experience, I believe that the reduction of the tumor is due to the direct action of the rays. Early in 1917 I began the treatment of a patient, aged thirty-four, with a fibroid about the size of a five months' pregnancy, the uterus extending to a location midway between the symphysis and the navel. After a series of three treatments, one month apart, this patient had a temporary cessation of menstruation, lasting three months. She then began to menstruate and has continued to menstruate normally since that time. At a recent examination by a gynecologist, the uterus was found to be normal in size. Did her uterus return to normal as a result of the temporary menopause, and if so, why did it not again enlarge with the return of ovarian function? I believe the reduction in this case, which began before the menopause, was due to the direct action of the rays.

Several cases subjected to radiation therapy by me, have later given birth to healthy children. The most recent case is that of a married woman aged thirty-one and mother of two children. About eighteen months ago she was referred to me for treatment for metrorrhagia, after having been curetted several times without relief. After two treatments, she ceased to menstruate for two months and then menstruated normally for two months, after which she became pregnant, and was recently delivered of a normal healthy child.

After roentgen-ray therapy of any portion of the body it is very important to warn the patient against any irritating applications to the skin. Of all these cases treated by me only one had a serious reaction in the skin. This occurred several years ago and was due to the fact that, for some unknown reason, this patient painted the entire abdomen with iodine soon after she had received a third treatment designed to induce the menopause. This combination resulted in necrosis of the skin over the area treated and necessitated excision of this area with suture of the healthy skin, the patient making a prompt recovery.

If, after roentgen-ray therapy, the patient complains of pain in the pelvis, especially if it be unilateral or develops fever or chills, the treatment should be discontinued. These symptoms indicate

the presence of some infectious process in the pelvis which has been overlooked. A single treatment will probably not seriously activate a latent infection, but repeated treatments most certainly would do so.

On looking up the literature on this subject, I observed that Dr. E. C. Titus in the discussion of a paper by Pfahler in 1913 was apparently one of the first to mention radiation sickness in these cases, which he described as a toxemia. About 25 to 30 per cent of cases treated by the above-described technique suffer from radiation sickness. In most cases this consists of slight nausea usually disappearing in twenty-four hours. A very small percentage vomit a few times, from six to twelve hours after the treatment. If this is at all distressing, subsequent treatments are divided by giving two treatments of thirty-five minutes with a two-day interval instead of a single treatment of one hour.

One should endeavor not to induce the menopause if it is possible to give the relief desired without doing this. In my experience, the symptoms due to an artificial menopause are more pronounced than when the same occurs naturally.

After it was demonstrated that the roentgen-ray treatment of mild gynecological lesions was capable of giving relief without surgery, many gynecologists took up this work and developed a technique for the use of radium. While similar results to those obtained through roentgen-ray therapy may be obtained by the intrauterine use of radium in many of these cases, I believe there are many reasons why roentgen-ray therapy should be the treatment of choice. Where radium is used, the patient must go to bed and usually to the hospital. In most of the cases an anesthetic is necessary. After radium, the radiation sickness is more pronounced than with roentgen-ray therapy. Many of the patients have irritability of the bladder and rectum and pelvic pain. Radium treatment is followed by a leucorrhea lasting several weeks. In young women, because of fear of inducing the menopause, a single treatment may not give relief, necessitating a second hospital visit, anesthesia, etc. The danger of activating a latent infection is greater with radium. The possibility also of introducing infection must be considered, where a foreign body is left in the uterus for some time. With roentgen-ray therapy there is no interruption to the ordinary routine life of the patient.

DISCUSSION

DR. H. J. ULLMAN, Santa Barbara, Cal. There was a point brought up at the end of the paper which I think merits a little discussion, and I hope will bring out some experiences from some of the other men. That is the comparative expediency of radium or the roentgen ray in certain cases, certain types of individuals, or certain types of fibroid uteri. In the older persons it makes little or no difference whether roentgen castration is produced or not. In younger persons it makes considerable difference. I am not referring to the possibility of rendering them sterile; I am referring to the stoppage of menstruation only, whether they are rendered sterile or not. If we place radium in a uterus, the center of radiation is at an appreciable distance from the ovaries, and therefore the endometrium will receive the largest dose at any given time, the musculature of the uterus and the fibroids will receive the next less degree of intensity, and the ovaries the least. Now, if a comparatively small dose is given, the parts will recover in the inverse order, the ones farthest from the radium will recover first, that is, the ovaries. So that if we space our radium applications properly, we will reach a point where the radium is applied before the fibroids and the uterus itself recover, and after the ovaries have recovered, taking it for granted, of course, that the original dose was below the ovarian injury dose.

In practical work you can reduce a large uterus, of the size of a three months' pregnancy, with two or three applications of radium to the size of an atrophic elderly uterus, with return of menstruation in from three to six months. The same thing can be done with the roentgen ray if a small portal is used and small fractional doses are given. This is more after the French School, where the attack is on the uterus itself rather than after the German School, where the desire is to produce castration, letting that take care of the fibroids. So that I think we should not compare radium and the roentgen ray from the radiation standpoint only; we should consider the individual in deciding which we are going to

see. I have yet to see cases of fibroids in which radium was used in small doses, in several applications, where there was as much illness, or malaise, as after the roentgen ray.

Dr. Keith, Louisville, Ky. We have had several cases of essential hemorrhage in patients under twenty years of age in which the dosage, using 50 mg. of radium, has not been more than two hours' time. One case, a girl seventeen years of age who had been bleeding for three and one half years had gone through the regular surgical routine, been curetted several times, and has laparotomy done without results. We started out with Dr. Ullmann's idea of giving this girl probably three or four doses, and as she was very much under par. We told her mother we were only going to give one hour dosage, which we would probably have to repeat two or three times. Owing to the difference between my watch and the clock in the ward of the hospital, this girl received 42 mg. hrs. of radium with silver filtration. She menstruated six weeks after that, and it is now nearly three years and she has not missed a normal menstruation since.

Another case, treated for two hours, with 50 mg. of radium, menstruated twenty-eight days after the treatment and has not missed a normal menstruation in two years. It is now two years since treatment.

One point I want to object to is the use of anesthetics in introducing radium into the uterus. I am sure if you are careful, tender, and gentle in your manipulations, there will not be 5 per cent of your married patients who will require an anesthetic. I have made intrauterine radium applications in women that were unmarried, and the greatest pain they had was in dilating the vagina.

We had a patient two years ago, then aged forty-two, who had a fibroid that practically filled the pelvis. She had a double heart lesion and had had double pneumonia the winter before, so it was thought inadvisable to give an anesthetic. We made an effort to do this without the anesthesia. Her greatest pain was in dilatation of the vagina. The treatment was carried on without any anesthesia. I am sure 5 per cent, or probably less than 5 per cent, is all that will require an anesthetic, and those of you who have tried this without anesthesia know you can take very sharp toothed forceps and catch hold of the cervix, and if you do not get too large a bite and use a too heavy instrument, in which you will cause pain by pinching, the patient cannot tell when you do it. We prefer to give intrauterine applications without any anesthesia simply because we do not have any possible anesthetic nausea, we do not have to pack the cervix tight, our patient will go to bed, and we have no fear of the radium being displaced by post-anesthetic nausea and vomiting.

THE TREATMENT OF CANCER: A MEDICAL RATHER THAN A PHYSICAL PROBLEM*

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WHEN a new remedy is first reported, it is hailed by many as a panacea, something that will save, not only the sufferer's life or health, but will also save the attending physician thought and labor. If the condition is diagnosed as syphilis, all the physician needs to do is to give an injection of salvarsan; if diabetes, insulin; if the diagnosis is uncertain, use pluriglandular therapy. It is soon found, however, that salvarsan, in a definite dose, is not curative for every luetic patient, that insulin requires careful study of the individual's needs to be the wonderful agent it is when properly used, and that it may be an exceedingly dangerous agent in overdosage. If all diabetic patients were given insulin in the same manner, some would be killed, some unaffected and a few benefited.

The treatment of malignant growths by the new short-wave therapy was hailed as a method, which, while not a panacea, would make radiotherapy mechanical and easy. One had only to make a diagnosis and then apply the indicated radiation. The radiation was that indicated for the tumor in question, the patient receiving very little consideration. Death from roentgen cachexia was considered a necessary evil. One read of the "carcinoma dose," the "sarcoma dose," etc., and the aim, so far as one can gather from the literature, was to put that amount of radiation into a given tumor with little or no regard for the individual who was the unwilling host. Soon reports of untoward effects appeared. It reminds one of the early days of salvarsan in massive doses. Liek[1] stated last year (1922) that the number of injuries caused by roentgen radiation was alarmingly high, even in clinics conducted by the greatest experts in this line, and that it was particularly true in the treatment of tumors by the most intensive and hardest radiation.

This attitude toward standardization in the problem of radiation dosage is natural. We are always searching for simplification in the complicated task of combating disease. The more mechanical and standardized it can be made, the less thought and labor is required. It seems to be the modern attitude in the practice of medicine, this desire to substitute the mathematics of the laboratory for the laborious weighing of all the evidence of the clinician. It is time that we attacked the problem of the treatment of cancer from the broad field of Medicine rather than from the narrow one of Physics alone. Medicine in its broadest sense includes any branch of Science that may bear on the problem. We have depended too much on physics and biophysics, although without their foundation we would be nowhere, and we must continue to depend on them to strengthen and broaden that foundation.

There has been a tendency of late to appreciate more and more the rôle of the body as a whole in the reaction of tumors to radiation. Evidence that individual differences in bodily reactions play a large, if not a major part in the favorable results of radiation, is increasing rapidly. Loeb[2] states that the main effect of radiation is one injurious to tumor cells, but secondarily bodily reaction may play a part, both through contiguous tissue reaction and through distant action. Opitz[3] has found that where the tumor alone is irradiated, with the body protected, the result is less certain than when surrounding tissues are included in their radiated area. Opitz[4] also believes that the idea of completely destroying the cancer by means of a single irradiation must be considered unattainable, except in a few incipient and especially favorable cases. He uses stimulating radiation of thymus and spleen as adjuncts to the radiation of the tumor.

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Hesse[5] thinks that the reaction capacity of the surrounding healthy tissues and the general resistance of the organism must play an important rôle in roentgenotherapy. Failla[6] states that even though the amount of radiation necessary to destroy a certain tumor is known and administered it does not follow that the patient will recover, and Ledoux-Lebard[7] does not believe that an absolutely uniform technique can be adopted, for apparently identical tumors differ widely in their sensitivity to radiation. Cannot this be explained on the basis of varying body reaction in different individuals with the same kind of tumor?

This rôle of both body and tissue reaction in radiation effects on tumors has been emphasized by Ewing.[8] He states that the rather variable response of different tissues to radiation may be greatly altered by previous structural changes and other pathological conditions, and this is especially pertinent when they concern the state of the tissues immediately adjacent to a tumor that is being irradiated. It is upon the reaction of such tissues that the result of the radiation will largely depend. To quote the same author: "The therapeutic goal varies with many complicating circumstances, and each case becomes a study in itself." . . . "The idea that anything approaching a uniform dosage can ever be established for all the various forms of cancer, or all the varieties of sarcoma, can be entertained only by those who deal with a few common types of cancer, which they imperfectly observe, or by those whose work is confined to the experimental cancer laboratory. This attempt to substitute physics for biology and medicine can only prove an obstacle in the way of sound progress in radiotherapy. The conception of a standard dosage seems to emanate mainly from the notion that radiation cures cancer by killing cancer cells. The idea is an inheritance of the old surgical point of view, that the cancer must be extirpated, root and branch." . . . "It is clear that the reaction of the tissues is an essential factor in the curative process. Under some circumstances, when this reaction fails, no amount of radiation succeeds in killing the tumor cells." He has seen tissue after heavy radiation, where necrotic stroma tissue supported well-stained and apparently viable tumor cells. He believes that the most detailed knowledge we possess indicates clearly that the curative action is not the result of a direct effect exclusively upon the tumor cells, but involves especially a peculiar reaction of the normal or invaded tissues.

Russ, Chambers and Scott[9] found that prolonged exposure of rats to radiation resulted in severe wasting and death; at a reduction in the exposure, a growing animal will retain its health, but with a diminished rate of increase of body weight. As the dose of radiation becomes less, a stage is reached when the rate of increase of body weight exceeds that of the normal animal; and, when the animal is given these very small doses, it is found to develop a state of increased resistance to an implanted tumor. They also found that if small, repeated, daily radiations were given to the inoculated animals, with the tumor area protected, there was a slowing up of the tumor growth, but that there was much less retardation if the tumor received these small doses at the same time. They believe that there is ample evidence that large generalized doses of radiation lower the normal resistance to tumor growth, but that this result is reversed when small generalized doses are given at frequent intervals, while the tumor is left un-irradiated. If the size of these daily doses was varied, it was found that the more prolonged did not give the higher immunity.

Murphy and Morton,[10] Mottram and Russ[11] and Prime[12] have shown that after very large doses of roentgen rays an immune animal becomes temporarily susceptible to carcinoma and sarcoma inoculation.

Chambers, Scott and Russ[13] found that a single, rather large dose of roentgen rays increased the susceptibility of the animals to inoculation with spontaneous rat carcinoma.

There is a physical factor which is, as a rule, only considered from the viewpoint of penetration, the ability to place radiation at a given depth, i.e., the wavelength. It is generally considered true

that the effect produced is entirely due to the quantity of radiation absorbed and is independent of the wave-length. The preponderance of evidence is, at present, in favor of this, but there are certain considerations that, in the author's opinion, suggest that further work may alter our viewpoint. Coliez[14] has found that with either radium or roentgen rays, as the wave-length decreases, the difference between the lethal dosage for healthy cells and that for cancer cells seems to increase. We all know that with long-wave, aluminum-filtered radiation permanent epilation occurs. The author has yet to see permanent epilation after short-wave, copper-filtered radiation even when there is severe reaction with erythema, edema, scaling and tanning. As the velocity with which an electron is driven from an atom is a function of the frequency of the incident radiation, and as higher frequencies are required to affect inner-ring than outer-ring electrons, it is reasonable to expect that the higher frequencies should produce somewhat different effects from the lower ones. An electron leaving an atom at a high velocity is more likely to travel a great distance than is a slower one before recombining, is less likely to recombine with the same atom and more likely to produce disturbances in neighboring atoms. Electrons dislocated from inner rings are more likely to produce fundamental changes in their atom than those from outer rings. It is sometimes possible to produce better effects with gamma rays in certain instances than with roentgen rays, and these rays differ only in their frequency.

If we consider the evidence we have today, we must conclude that it is preponderantly in favor of the following hypotheses:

1. That tumor cells are not killed in the ordinary sense by radiation.

2. That to obtain a cure, we must give not only a quantity and quality of radiation that will be detrimental to the tumor, but also one that will not break down the bodily defenses.

3. That the proper dosage should stimulate bodily resistance or reaction in addition to injuring the tumor cells.

4. That heavy radiation renders the body, as a whole, more susceptible to tumor growth, while light radiation makes it more resistant.

5. That the proper or optimum radiation in any given instance depends not only on the type of tumor cell but on all factors which involve the physical condition of the host—his ability to react in the desired manner.

In short, it means that we must approach the cancer problem as clinicians in the broadest meaning of the word. We must realize that we are treating an individual afflicted with cancer rather than simply treating a cancer. What advantage is there in giving a dose that would cure the cancer provided the patient lived long enough, only to have him die, not of his cancer, but of roentgen cachexia, or to so reduce his bodily resistance that he dies of the cancer in less time than if untreated? Is it not better to inhibit the growth from year to year, giving the patient several years of comfortable existence than to cure it and shorten his life? Let us consider our patients from the standpoint of the physician and choose that treatment which will give them the most comfortable existence for the longest time. Would it not advance our knowledge faster to cease searching for the carcinoma dose and determine the best treatment for certain types of individuals with given forms of tumors, rather than the best treatment for each form of tumor itself? Should we not look for certain optimum general reactions, rather than skin erythemas, and should we not combine, in every case, all factors tending to increase bodily resistance rather than depend on treating the tumor alone?

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DISCUSSION

Dr. W. H. Stewart, New York. I am heartily in sympathy with Dr. Ullmann's paper. It might be interesting to you to learn something of my observations made this summer while abroad. The general tendency is to give a fractional rather than a massive dose. This does not apply perhaps to Wintz and Seitz but nearly all other workers are found to be reducing their length of daily treatment. I quite agree that we should treat the carcinomatous patient and not the carcinoma.

Dr. Jaches and I had an interesting session with Dr. Sydney Russ[9] of London. He brought out one of the main points, namely, that the maximum susceptibility of the cell to radiation was at the point of mitosis, and that this was constantly occurring. This would seem to favor the use of radiation over a more extended period of time than is usually given when the massive dose technique is employed.

In the Radium Institute at Paris where some very wonderful work was being done, Dr. Coutard, who has charge of the roentgen therapy, gives exceedingly low fractional doses. In fact, several of his cases are under treatment at least a month before they receive the full amount. He claims to control roentgen sickness by small doses—increasing filtration and diminishing the size of the field. He expects a gain of weight while under treatment. In one case the patient gained 30 lbs. while under treatment for a carcinoma of the breast.

Dr. C. L. Martin, Dallas, Tex. Since I have for several years been interested in the clinical effects of roentgen rays, I would like to say a few words in support of the conservative note sounded by the essayist. The treatment of a patient should be undertaken only after most careful consideration of all the factors involved. It seems to me that the phrase, "be a clinician," was the keynote of this paper. A carefully taken history, a searching physical examination, good preliminary and aftercare and the selection of a dose fitted to the individual are points that are sometimes lost sight of in a zealous effort to follow out a physical formula in the shortest possible time. We should, I think, know as much as possible about the behavior of tumors when unmolested in order that we may judge the effects of treatment. An exact knowledge of the metastatic possibilities in each case is valuable in making physical examinations and in administering efficient treatment. Patients too often die of metastases in some remote part of the body while we are hammering away at the primary lesion. We need more textbooks like Dr. Ewing's excellent treatise on "Neoplastic Diseases."

Since beginning deep therapy we have made it a rule to keep the patients under treatment in the hospital, thereby making it possible to enclose good histories and physical examinations in our records. We are also attempting to work out a system of medication and diet well suited to such cases. The clinical side of this work is certainly most important.

CONTROL OF HYPERTHYROIDISM*

BY KENNON DUNHAM, M.D., AND JOHN H. SKAVLEM, M.D.

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THE efficiency of roentgen-ray treatment for the relief of hyperthyroidism is proven. We shall not discuss this phase of the problem but shall attempt to point out some of the medical factors, the recognition of which is essential to carry roentgen-ray treatment to a successful cure. Before any case is accepted for roentgen-ray treatment the doctor must be protected; first, by accurate and complete diagnosis; second, by a knowledge of how much irreparable damage has been done; and third, in order that he may know what to promise the patient, and what not to promise.

Hyperthyroidism is not a simple entity localized to changes in the thyroid gland. It constitutes a disturbed balance of endocrine secretions, with consequent far-reaching effects in all parts of the body. Its causes are not confined to the thyroid gland itself, but the overactivity of this gland may be but an end-result of another disease focus. To confine treatment to the gland alone will lead to failure in many cases. Therefore as I have stated, correct diagnosis is the first essential in the handling of the case. A scrutinizing search must be made for foci of infection in the teeth, tonsils, sinuses, lungs, bowel, gall-bladder, urogenital system and other parts of the body. Any focus present must be eradicated. Then again the diagnosis must be correct. Too often a palpable thyroid accompanied by a rapid pulse has led to the operating table for thyroid surgery. Cases of psychoneuroses may be totally masked by a pronounced hypertrophic goiter which is non-toxic. These non-toxic, neurotic patients with simple thyroid enlargement are dangerous pitfalls to the aggressive surgeon or enthusiastic internist, and often constitute a difficult thyroid problem, for they are definitely damaged by removal of thyroid tissue or loss of gland function. Such cases present themselves with rapid heart action, general nervousness, tremor, anxious look and a slightly enlarged thyroid, closely simulating a thyrotoxic syndrome. Frequently such individuals are extremely eager for radical treatment and encourage the prospect of a surgical operation. A mistaken diagnosis would lead to far less harm with roentgen-ray treatment than with a surgical operation entailing the sacrifice of such valuable tissue as that of the thyroid gland. But even unnecessary loss of gland function by the conservative roentgen-ray treatment is to be avoided if possible.

In the differential diagnosis, the determination of the basal metabolic rate is absolutely necessary. No case should ever be treated over any length of time without such a determination. Cases may occur where the patient is too nervous or too weak for such a test to be successfully carried out, and in such instances the treatments may be started, but should never be frequently repeated without the metabolism determination being made. To interpret correctly the metabolism test reading, the clinical course of hyperthyroidism must be understood. The hyperactivity occurs in waves or cycles. On one day the symptoms may all be very exaggerated and the metabolic rate proportionately high; on another day the symptoms may be much relieved and the metabolic rate proportionately low. This fact must be thoroughly recognized in both the diagnosis and the treatment of the case. The initial metabolic rate of a patient with exophthalmic goiter may be much higher than the subsequent tests, and even after a rest of ten days or more in bed the fluctuation from one day to the next may be as great as 20 per cent. The presence of fever must always be closely noted. It has been observed by Du Bois and his co-workers that with an increase in body temperature the basal metabolic rate rises in definite proportion to the temperature. If the temperature remains elevated and the food intake is not increased a proportionate amount, the patient will necessarily lose in body weight. In such cases there is an increased body

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surface in proportion to body weight, and the metabolic rate is proportionately high. This must be remembered in long-continued fever, such as in tuberculosis. In exophthalmic goiter the situation is more of a strain on the heat regulating and nutritive systems of the body. The increase in metabolism, which results from fever, is an increment which must be added to an already elevated metabolism due to the pre-existing goiter.

The determination of the basal metabolic rate brings us to a classification of goiters and their selection for treatment. The simple classification of toxic and non-toxic is best to follow for our purpose. Under these heads come the non-toxic simple colloid, the adolescent simple hypertrophied thyroid and the adenoma, which may or may not be toxic, and the hyperplastic exophthalmic type, which is always toxic. Any of these may undergo cystic or degenerative changes. The simple colloid goiter is purely a surgical problem; the adolescent simple hypertrophied thyroid is a medical problem and had best be let alone; the adenoma, if non-toxic, is not a roentgen-ray problem, but frequently thyroids of this type contain islets of hyperplastic tissue and toxic symptoms result; the hyperplastic exophthalmic goiter is truly toxic, and a medical roentgen-ray problem par excellence. The adenoma usually makes its appearance early in life, gradually enlarging, but usually not giving manifest or distressing symptoms until the age of menopause. The exophthalmic goiter usually appears in the twenties or early thirties and grows rapidly worse, with frequent remissions.

The most serious and frequent damage wrought by any goiter is injury to the heart. The cardiovascular changes are progressive, and in the severe cases of toxic goiter, dominate the clinical picture. The cardiac signs and symptoms differ only with the degree of toxicity. Two big factors are responsible for the heart changes in goiter cases; first, the mechanical, as compression upon the great vessels, trachea and large nerves with consequent cardiac and pulmonary embarrassment. Another mechanical factor which has received emphasis from Boas, is the fact that in exophthalmic and simple goiters there is a tremendous increase in the vascularity of the thyroid gland; the thyroid arteries and veins are greatly dilated. These dilated blood vessels of the thyroid gland act as a shunt, which short-circuits a large part of the blood from its usual course to the head, and returns it immediately to the heart. This persistently increased load on the heart must result in dilatation and hypertrophy and, if long continued, in myocardial insufficiency. Roentgen-ray treatments always produce some fibrosis and contraction of blood vessels. Such procedure and change would be beneficial in this condition. The second factor in heart change is the toxic substances, which are related to the increased activity of the thyroid gland, acting through the cardiac nerves or directly on the myocardium. At necropsy the heart in exophthalmic goiter usually exhibits moderate hypertrophy and dilatation of both chambers, with fatty infiltration of the heart muscle-cells. In some cases small scars with interstitial or perivascular round-cell infiltration are found scattered through the heart muscle. Endocardial lesions accompanying toxic goiter are rarely found.

Cardiac irregularities are very common. Auricular fibrillation or auricular flutter, usually paroxysmal in type, occur in an appreciable percentage of all cases. In hyperthyroidism there is a stimulation with production of hypertonus of the entire sympathetic or vegetative nervous system.

Symptoms. In early cases there is an alert look in the eyes, frequent winking, a tense expression, and a quickening of mentality. There is dyspnea and fatigue on moderate exertion. The appetite is usually good, in spite of which there is usually a moderate loss in weight. At first the patient will be unaware of the rapid pulse, but palpation will reveal a pulse rate of 90 to 100 per minute. The rapid heart action continues even while the patient is resting or asleep. This observation serves well to differentiate a psychoneurosis in some cases. In goiter the pulse is full and forceful and there is a singular immunity to the slowing influence of digitalis even in large doses.

Later the patient becomes aware of almost constant palpitation. The dyspnea becomes worse and precordial pain or uneasiness is complained of. In the course of events there is evidence of beginning myocardial exhaustion. Compensatory hypertrophy leads to dilatation and a murmur of mitral insufficiency is commonly heard. Either prior to or about this time, auricular and ventricular extra systoles, pulsus alterans, auricular flutter and fibrillation may occur. Auricular fibrillation is very often unassociated with murmurs. It is apt to be paroxysmal in occurrence.

In many of these pitiable advanced cases, in which the myocardium has undergone changes incident to decompensation, recovery from the syndrome of hyperthyroidism is coexistent with the continuance of heart lesion. This is similar to conditions commonly seen following abatement of the usual organic heart disorders. A patient of this type, although cured of the hyperthyroidism, still requires attention with regard to the heart, and may remain, to an extent, an invalid throughout the rest of life. This situation is usually traceable to a belated diagnosis and a postponement of rational treatment.

It is not uncommon for a heart to remain persistently rapid after recovery from hyperthyroidism, even though no heart damage can be demonstrated. Occasionally an undue slowness of the heart, amounting to actual brachycardia, may occur. This is in no way connected with a hypoactivity of the gland, and injections of thyroid extract would be distinctly detrimental. The possibilities of these persistent disturbances of heart rate, and the presence of actual damage to the heart muscle or nerves must be thoroughly understood by the patient.

Guarded by a complete diagnosis and an understanding of the damage already wrought by the goiter, promises of recovery to the patient can be made. Roentgen treatments of the thyroid gland will reduce the activity of the gland and relieve the symptoms of the toxic syndrome. Decrease in the size of the tumor or relief of pressure symptoms may occur, but they cannot be expected in all cases, nor should they be promised to the patient. A few cases will show marked decrease in size of the neck and relief of pressure symptoms; then the next case may receive absolutely no such relief. A patient seeking treatment of a goiter simply for the cosmetic effect of reducing the size of the neck, should be warned that this is not always possible by means of roentgen treatments. The largest goiters are usually the adenomas. In such cases roentgen treatments are effective in preventing an increase in the size of the gland and in reducing any hyperactivity in the functioning of it. In this way the heart is spared the damaging changes of the toxic activity. It is a noteworthy observation that in all of our experience of roentgen-ray treatment of the thyroid gland, we have never seen a malignancy of the gland develop. We have irradiated many adenomatous goiters to prevent the increase in size and reduce the toxic syndrome. Malignant changes are most frequent in the adenomas. It is our conviction that roentgen treatments of adenomatous goiters serve as a preventative of malignant changes in the gland.

In handling a case of toxic goiter it is to be remembered that there is a distinct and large mental factor in the disease. With the stimulation of the sympathetic nervous system comes a very alert mentality; the patient is irritable and peculiarly sensitive to excitement, worry, fear and crowds. The relief by a surgical, medical or roentgen-ray cure can be completely undone by a single great fear. The benefit of each single roentgen-ray treatment can be entirely lost by the discouragement of friends or relatives or the indifferent, impersonal attention of the doctor. The problem of roentgen treatment of goiter is entirely different from any other roentgen-ray treatment. When dealing with a malignancy you can conceive of the lesion as an inanimate new growth apart from the personal being of the patient, and hammer that lesion with roentgen rays until the autonomous tissue is destroyed. In toxic goiter the hyperactive thyroid gland is but the abused organ of a generally disturbed and damaged organism. The personal being of the patient is upset and reacts like a barometer to the reaction

of stimuli from the goiter toxins, or stimuli from without. A vicious circle is established in which the mental disturbance of the patient is in proportion to the toxicity of the gland and increased mental disturbances from without produce an elevation of the toxic activity of the gland. Following each roentgen-ray treatment the patient ought to be given at least a ten-minute interview with the doctor, during which time he must build the mental attitude of the patient. Constant encouragement and cheer is necessary. Positive assurance of relief, within the bounds of your first promises, must be given. The home life, work, rest, pleasure and sleep must be outlined. The very habits and thoughts of the patient must be given guidance.

I have seldom found it necessary to place the patient absolutely in bed, although in an extreme case this is advisable. It is frequently necessary, however, to insist on graded hours of rest throughout the day and to give sedatives to promote relaxation and sleep. Luminal proves a very valuable drug for this purpose.

Intensive deep roentgen therapy is not necessary for the usual toxic goiter. In our laboratory the following technique is used: 9 in. spark-gap; 5 ma., 12 in. distance, 4 mm. Al filter; 7 min. exposure, or 35 ma. min. The thyroid and thymus are covered in three areas, one over each lobe and one over the upper sternum. The larynx is carefully protected. The treatments are repeated at intervals of three weeks. In exaggerated cases it proves valuable to give one exposure over the back of the neck in order to increase the dose to the gland. The number of treatments cannot be estimated absolutely and should never be promised to the patient. Their sequence depends entirely upon the progressive decrease in the basal metabolic rate. The conclusion reached by some workers, that five or six treatments tell whether or not the case will respond to the treatment, in our experience is not justified. Many cases would be judged failures at such a time, and yet if the roentgen treatments are fearlessly pushed and the patient is properly handled, relief is sure.

In the female, it is sometimes necessary to stop the menses before relief can be brought about. This is true only in exaggerated cases of long standing and most commonly in cases near the age of menopause. This procedure should be promptly advised when you find that the menstrual epoch is causing an exaggeration of symptoms and a marked increase to the basal metabolic rate. The cessation of menstruation can be readily brought about by a few roentgen exposures over the ovaries.

The only two cases we have ever registered as failures were due to the fact that the patients were persuaded to discontinue treatment too soon and to undergo surgical operation.

SUMMARY

Hyperthyroidism is not a simple entity with pathological changes limited to the thyroid gland. It is a generalized neuro-endocrine dysfunction in which swelling and hyperactivity of the thyroid gland is an incident. Before the treatment of any case of hyperthyroidism is undertaken complete and correct diagnosis is necessary, the damage already wrought to the body must be determined and promises of relief governed accordingly.

Relief may be promised from hyperthyroidism but relief must not be promised from all the patient's symptoms. Many damaged hearts recover, but some do not.

There are several excellent tests for hyperthyroidism besides basal metabolism. For our purpose we believe that a knowledge of the symptoms, appreciation of the psychology, and understanding of the pathology of these cases and the intelligent use of roentgen-ray and basal metabolic outfit, is all that is required.

All of this is to say that the roentgenologist must be a physician, not a machine operator, if he hopes to treat hyperthyroidism successfully.

ABSTRACT OF DISCUSSION

Dr. Holmes said that he did not agree with Dr. Dunham in his opinion that all cases of hyperthyroidism should be treated by roentgen therapy, neither does he think that all cases

should be treated surgically, as he had heard an eminent surgeon say a short time ago.

By a study of the symptoms, duration of the disease, character of the lesion, and the social condition of the patient, it is often possible to select the cases that are more favorable for roentgen therapy and those more favorable for surgery. A long-standing case with a hard and possibly cystic goiter does better under surgery, while an early case, with considerable toxemia, may be dangerous for surgery and will do well under roentgen therapy. The end-results in his experience have been about the same for the two methods of treatment.

Dr. Holmes called attention to recent work at the Mayo Clinic, which his own experience in a few cases seems to confirm. This consists in the administration of iodine, which seems to bring the basal metabolism down to normal and holds it there for some time. If this proves true, it will eliminate the objection to roentgen therapy that the patient remains toxic for a long time during treatment.

In answer to a question Dr. Holmes said that they were using Lugol's solution, the dose and frequency depending upon the severity of the case.

Dr. Dunham, in closing, said that he was in entire accord with the work of Dr. Holmes and his associates at the Massachusetts General Hospital, except in regard to the number of treatments that should be given before the patient is turned over to the surgeon. Sometimes many treatments are necessary before a cure is effected. Only cases that are toxic and which show an increased metabolic rate should be treated by the roentgen ray.

Dr. Dunham emphasized the importance of careful management of each individual case with the special object of keeping the patient in an optimistic frame of mind. He also advised especially against overdosage.

USE OF THE ROENTGEN RAY IN PERTUSSIS*

BY RALPH D. LEONARD, M.D.

BOSTON, MASSACHUSETTS

DURING the past winter and spring we have had in New England an unusually large amount of whooping-cough. It has again brought vividly to our attention the seriousness of this disease for young children (more than 10,000 dying from it in the United States last year), and the unsatisfactory state of much of the modern treatment.

A physician came into my office one day, saying that he had a patient three years of age who had been coughing and vomiting continuously for six weeks. He had been through the entire list of remedies, from serum to plasters, without relief. Having had some beneficial results with roentgen treatment in two or three of his "thymus" cases, he wondered if the roentgen ray might not be of some help in controlling the severe paroxysms of whooping-cough.

While an occasional case has been reported in the literature, in fact, a Russian physician reported 2 cases of pertussis treated by the roentgen ray in 1907, still I felt that such treatment would be more or less experimental. With this understanding, the patient was given 3 treatments the exposures being made every other day. The areas treated included the entire chest and lower neck, alternating front and back. The dosage given was that represented by 5 ma. with a 6 in. spark back-up for four minutes, at a focus skin distance of 14 in. using 1 mm. of aluminum filter. The total dosage was thus well within the limits of safety. We felt that if the roentgen ray was to be used, it must be in such doses that there would be no risk to the skin, thyroid or thymus glands.

In this particular case, during the period of treatment, five days, the vomiting entirely ceased and the paroxysms were reduced from an average of sixteen a night to four. The improvement proved to be constant, and within ten days the child was clinically well.

We realized full well that this may have been a simple coincidence, the treatment being applied at a time when the normal convalescence was about to begin. Nevertheless, in the light of the abrupt change for the better, it seemed reasonable to assume that the roentgen ray may have been a therapeutic factor.

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

Further evidence being desirable, I at once treated a series of 50 cases which were clinically pertussis, using approximately the same dosage as in the first case, although several received 4 treatments and the time was varied somewhat according to their age.

The results in this series, crude and unreliable as some of the evidence was, were such as to convince me that the roentgen ray must be a factor in controlling at least the symptoms in certain phases of the disease.

I, therefore, presented these preliminary findings to the staff of the Boston Floating Hospital, who made it possible through the trustees to assign the "On-Shore" department of the Floating Hospital for the study of whooping cough and in particular, the use of the roentgen ray in its treatment. Sufficient funds were furnished for the installation of apparatus, for laboratory facilities and for the employment of nurses and technicians.

The work was carried on over a period of three months during which about 400 patients were examined and treated.

The patients were all seen as out-patients. The Board of Health and Red Cross readily furnished conveyances for the children to and from their homes.

All diagnoses and clinical examinations together with the clinical observations as to the course of the disease were made by members of the Staff of the Floating Hospital, one or more of whom were always on duty during the clinic hours.

We had a permanent bacteriological technician with a consulting bacteriologist. Cultures were taken from all cases. We hoped to establish a simple method of diagnosis by isolating the Bordet bacillus. In this we have been disappointed, for even under the direction of Dr. Mallory we were not able to obtain a positive culture in a single case. Cultures were taken from the nose, the turbinate being curetted, the pharynx, larynx and trachea. During our series, however, there was one death and Dr. Mallory was able to demonstrate by means of section the Bordet bacillus lying within the tissues of the trachea. It is possible that our failure to obtain cultures was due in part to the period of the disease in which the patients came for examination, the great majority of them being seen at the height of the disease in the severe paroxysmal stage. It is possible that in the early catarrhal stage, the bacillus might be easily isolated. Our experience at least may throw some light on the relative contagiousness of the different periods.

Physical examinations were routine on every child at each visit, temperature being recorded.

Roentgenographic examinations were made of the chest before and after treatments. This phase of the work I will take up later.

The routine roentgen treatment was carried out along the same general lines as in the first few cases. We felt it wise not to vary the method to any extent, thus making it easier to draw conclusions from our results.

Each child was given four treatments unless immediate improvement followed the second or third treatment. A treatment was given every second day, alternating front and back.

In addition to the 400 cases treated with the roentgen ray we also followed and tabulated for comparison 200 cases which were not so treated.

In practically all the infectious diseases of childhood, we find enlarged bronchial glands. I had the opportunity a few years ago of seeing many films taken of chests of children suffering from measles, scarlet fever and diphtheria in the Contagious Department of the Boston City Hospital. In none of those cases did I observe the glandular enlargement to be anywhere near the enlargement which I found in these pertussis cases.

While at the present time I cannot prove it, still I am of the opinion that the greatest degree of glandular hypertrophy occurs at about the third week of the disease. This is the period when clinically one finds the paroxysms well established. It is also in this period of the disease that the roentgen ray seems to produce its most beneficial results. It is our theory at the present time that probably by its direct effect on the bronchial lymph-nodes the roentgen ray produces the relief of symptoms.

I will admit at once that the difficulties in obtaining an accurate idea as to the *results* of the treatment are so great as to be a possible source of error in our conclusions.

The differentiation of normal convalescence from improvement resulting from roentgen treatment was one of our greatest difficulties. Any sudden change for the better occurring during or shortly after treatments was usually considered a result of the treatment.

There was considerable difficulty in getting the mothers or attendants to keep an accurate record of the number of paroxysms, vomiting spells, and to give us some idea as to the general condition, appetite, sleep and temperature.

We early found that the *diagnosis* of pertussis is not always easy and is practically impossible in its early stages. You may be sure "that not all is whooping-cough that whoops." Incorrect diagnoses would certainly lead to incorrect conclusions.

Furthermore, many of the patients were receiving other forms of treatment besides the roentgen ray. A small percentage were receiving serum. This would also tend to make our conclusions somewhat inaccurate.

I will not attempt to present in detail at this time our tabulated figures. Suffice to say that the patients have been grouped and classified from various angles—age, stage of disease, clinical symptoms, roentgenographic findings, etc. Accurate tables were kept of the number of daily coughing paroxysms, vomiting, general condition, and the relation of these symptoms to the roentgen treatments.

From the evidence tabulated to date, we are of the opinion:

First, that the roentgen ray relieves symptoms in at least 75 per cent of the cases, when used in the paroxysmal stage. In special groups, for instance in children under one year of age, nearly 100 per cent were definitely relieved. This may indicate that we are not giving just the proper dosage in the older patients.

Vomiting is one of the symptoms which is promptly relieved. We find diminution in the severity of the paroxysms and frequently a marked diminution in the number. Occasionally, there will be a drop from about twenty paroxysms in twenty-four hours to two or three. This relief of symptoms usually takes place during the course of treatment or within a day or two of the last treatment.

Second, that the roentgen ray does not seem to shorten the course of the disease to a marked extent, and when used in the early stages does not seem to prevent the onset of the paroxysms. Here, again we find some discrepancy in our tabulated figures. For instance, in our series of 400 treated cases, there were 49 between one and two years of age. The average duration of the disease in this group was 5.5 weeks. In our series of 200 untreated cases there were 42 between the ages of one and two years and the average duration of the disease was 8.7 weeks. These figures tend to show that in children of one to two years of age the roentgen ray did tend to shorten the course of the disease.

I think it is fair to say that up to the present time, in the opinion of the Staff of the Floating Hospital, we have in the roentgen ray one of the best means for at least controlling the severe symptoms of whooping-cough.

Our efforts will continue during the coming winter, when in addition to the outpatient clinic, we shall have 10 beds. This will allow very careful observations of a few selected cases.

ABSTRACT OF DISCUSSIONS

Dr. K. Dunham, Cincinnati. Emphasized the common occurrence of broncho-pneumonia in whooping-cough and thought possibly the good effect of the roentgen treatment is due, at least in part, to its action as an aid to resolution in pneumonic conditions.

Dr. H. J. Ullman, Santa Barbara, Cal. Asked if Dr. Leonard thinks the effect of the roentgen ray is primarily on the glands or if there is a possibility that it is analagous to the general effect secured in treatment of elderly people with bronchial asthma.

Dr. Kinney, San Diego. From experience he has arrived at the same conclusion as Dr. Leonard—that in approximately 70 per cent of the cases the patients had an easier time as judged by the lessened paroxysms and cough. The duration of the disease is not shortened.

Dr. R. D. Leonard (closing). I rather felt that this evidence of infiltration in the

lung tissue was a type of pneumonia. The only difficulty is that it is not clinically pneumonia, there was no appreciable temperature, the children felt perfectly well and ran around just as other children.

In answer to Dr. Ullmann's question, I feel that the effect of the roentgen ray is perhaps somewhat the same as in the so-called thymus cases. We apparently get some effect clinically from raying the thymus, the improvement is immediate, but there is no demonstrable change in the size of the thymus. The same with these glands. We irradiate them, there is an immediate effect on the symptoms, but no appreciable change in the glands for some weeks. Now I think there must be some other effect of the roentgen ray besides the direct diminution in the size of the glands. There may be a general effect, just as we get in certain types of asthma.

The matter of where, and how, to treat this class of patients is a problem. Of course you cannot have them in your office at the regular office hours, and we found just having a separate institution the best way to handle that. If this treatment works out as a real necessity in whooping-cough cases, I think the roentgenologists in one community will have to get together and cooperatively run a roentgen whooping-cough clinic in some separate location. I don't see any other way to handle it.

This report, as you appreciate, is just a preliminary statement. I bring it here mainly with the hope that some of you who are experts in roentgen treatment, in measurement and dosage, etc., can give me some suggestions as to how to vary the dosage safely, so that during the coming year we can perhaps have a little more definite results to report.

MEASUREMENTS ON TWO AMERICAN AND TWO GERMAN DEEP THERAPY MACHINES BY MEANS OF THE DUANE METHOD AND THE FRIEDRICH IONTOQUANTIMETER*

BY GEORGE E. PFAHLER, M.D., AND BERNARD P. WIDMANN, M.D.

PHILADELPHIA, PENNSYLVANIA

THE space and circumstances of our offices led us to install four different types of deep therapy outfits. They are: the International, the Rieber, the Veifa Neo Intensive and the Symmetrie machines. The first two are made in America and the other two in Germany.

The object of our investigation was to measure the output of each of these machines with the Friedrich Iontoquantimeter, which is recognized as the high standard measuring instrument in Germany; and at the same time to make similar measurements with the Duane method, which is recognized as the best in America.

We reasoned that we should be able, as a result, to determine: (1) the relative output of these four machines; (2) the relative value of the German and the American units of measurements; and (3) the relative value of the two measuring instruments. We had hoped that this information would enable us to interpret the German units of dosage and technique in such a manner that roentgenologists of each country could profit by the experience of the scientists in the other country. We would be enabled to talk the same language, or each other's language.

Toward this end, we secured the services of Dr. Kurt Behne, who had worked with Prof. Friedrich with the iontoquantimeter for about three years. We assumed that his familiarity with the iontoquantimeter and its development would guard us against error. Unfortunately it was two and one-half months from the time the iontoquantimeter was ordered until it was received. This brought us close to the vacation period. Even then, Dr. Behne did not believe that the instrument was accurate, and certainly the dosage as measured by the iontoquantimeter was in great discord with our clinical experience and observations. Because of these difficulties we are not entirely satisfied, but we give our results for what they are worth.

* Read at the Twenty-fourth Annual Meeting of THE AMERICAN ROENTGEN RAY SOCIETY, Chicago, Ill., Sept. 18–21, 1923.

A preliminary paper bearing upon this subject was presented before the Radiological Society of North America on December 7, 1922 (Measurements on Two American Deep Therapy Machines, with Special Reference to the Duane Method. *J. Radiol.*, July, 1923) by one of us (Pfahler), in which was described the detailed steps used in making measurements by the Duane method. The method has been more scientifically described by Prof. Duane in various papers (Duane. Am. J. Roentgenol., March, 1922, July, 1922, and Dec., 1922, and in its principle in 1914).

This description will not be repeated here. We regret that the entire object of this paper cannot be realized because of various difficulties, and we hope that some physicist will succeed in working out this data. It is extremely difficult to make exact comparative measurements of such a character in association with a crowded clinical practice. Primary voltage changes, atmospheric variations and disturbances in the individual machines occur from day to day and hour to hour, and unless all measurements are made simultaneously, or each factor controlled and all errors eliminated, the measurements have little scientific value. Therefore if we give some of our practical observations as clinicians we will probably accomplish more than to publish a great mass of figures which are not in entire accord.

1. We found that on its arrival in March, the natural discharge of the iontoquantimeter—in the absence of any radiation—was 25 minutes. In June, the discharge of the 10 units on the electroscope took place in 12 minutes. At no time did the measurements of the iontoquantimeter accord with our clinical observations as to the erythema dose, under the conditions of the test. For instance, our maximum erythema dose as given on the Rieber machine measured only 53 units on the Friedrich iontoquantimeter, even when this larger natural leak was considered. Therefore if one gave upon this basis 170e as measured by this instrument, the dose given would have been 320 per cent of what we consider our maximum dose. This naturally has led us to discard it, for the present at least.

The practical point of this is that one cannot import such a delicate measuring instrument, even of the highest grade, and consider it entirely reliable. It should be carefully investigated by a physicist and standardized before dependence is placed upon it. Fortunately we were able to control it by our known dosage, and also a known measurement. My instrument was examined by two physicists. They differed as to the fault, and the cost of repair was estimated at from $100.00 to $150.00, with no guarantee of efficiency. The primary cost to me was $442.00. Such experiences lead us to conclude, with Dr. Coolidge, that the average clinician had better depend upon the indirect method of measurement than upon ionization instruments susceptible to so much error.

2. In Germany, zinc instead of copper is generally used for filter. I asked Prof. Wintz the reason for this. He said it was purely a matter of economy, and that zinc was of the same filter value as copper. Zinc filters were furnished with the Symmetrie outfit; so, by means of the Duane method, we compared their absorption value with that of a corresponding thickness of copper, and could detect no difference between the two.

3. In some places a paraffin block, 10 × 20 × 20 cm. is used to measure radiation values. We found that this block added 19 per cent to the surface dose as compared with measurement in air. We then measured by comparison our water-phantom, consisting of an aluminum tank 1 mm. thick and 25 × 25 × 25 cm. in size, filled to a depth of 20 cm. with water. This added 20 per cent of secondary radiation to the surface dose.

The practical point about this observation is that we must always bear in mind that our surface dose will vary with the size and density of the portion of the body receiving treatment. A surface dose on an arm or hand will therefore require a longer time than a dose given over the abdomen.

4. We found that each machine worked most efficiently under certain conditions. The calculations following were based upon observations upon the four machines all made within an hour.

(*a*) *The Rieber machine* running from 220 volts, direct primary current, gives the

most efficient output when one uses 240 kv. and 3.5 ma. When this radiation is filtered through 0.48 mm. Cu. + 1 mm. Al. and 6 cm. of mattress, there is produced an effective wave-length of 0.156 Ångström units. When measured at a distance of 45 cm. and distributed over a field 12 × 16 cm. the intensity at the top of a mattress (the rays coming from below upward) is 0.1818 of an electrostatic unit of radiation. When measured at the under surface of the paraffin block (the ionization chamber being buried to its middle) the *intensity* is 0.2352 of an electrostatic unit of radiation. That means that the paraffin block (10 × 20 × 20 cm.) has added 32.5 per cent of secondary radiation. This will then approximate the average surface intensity as applied to the patient. This intensity of radiation of a value of 0.156 Å applied with the above filter for forty-eight minutes gives a mild erythema, which may be increased 20 per cent. The intensity of 0.2352 of an electrostatic unit of current when multiplied by the number of seconds will give the number of electrostatic units of charge "e" or 687e. If increased by 20 per cent it would equal 824e. The percentage depth dose as measured by this paraffin block was 38 per cent.

(*b*) *The Symmetrie outfit* runs most efficiently at 210 kv. and 2.5 ma. When these rays are passed through 0.5 Cu. + 3 Al. the effective wave-length is 0.148 Å. When these rays are passed from above downward to a distance of 45 cm. and in a field of 12 × 16 cm. and the ionization chamber is placed upon the mattress, the intensity is 0.1875 of an electrostatic unit of radiation current. At the surface of the paraffin block the intensity under the above conditions is 0.2352 E, or an increase due to secondary radiation of 32.5 per cent. The depth-dose value is 37 per cent.

Remarks. A comparison of the Rieber machine with the Symmetrie gives a beautiful illustration of the errors that would occur if one depended upon the indirect factors for measuring dosage, with the use of machines of different type and principle. With the Rieber machine we use 240 kv. and with the Symmetrie (coil type) only 210. With the Rieber we use 3.5 ma. and with the Symmetrie only 2.5, and yet in the two machines, under the above conditions, with like distance and like filter, the intensity is exactly the same and the percentage depth dose is practically the same.

This comparison would indicate that in principle the coil run by a gas mercury interrupter is better than the Rieber Booster type of machine; but in practical work one can use a higher voltage and a higher milliamperage on the Rieber, which exactly balances the output of the other machine. In practical efficiency as to the output, therefore, there is no difference.

(*c*) *The Veifa machine* works most efficiently with 200 kv. and 4 ma. This gives an effective wave-length of 0.162Å. when filtered through 0.48 mm. Cu. plus 2 mm. glass. They are sent from below upward, and at the surface of the mattress the intensity in a field 12 × 16 cm. is 0.1250E. At the under surface of the paraffin block lying on the cushion the intensity is 0.1611E, or an increase due to secondary radiation from the block amounting to 29 per cent. The percentage depth dose under the above conditions is 37 per cent. The intensity of surface radiation each second is 0.1611E. over a mass of organic substance of the size of 10 × 20 × 20 cm. and in one minute is 9.66e. Our mild erythema dose represented by 687e, when divided by 9.66e gives 70 or the number of minutes for a mild erythema dose on the Veifa machine with the given conditions. A maximum dose is approximately 20 per cent more, or 84 minutes.

(*d*) *The International machine* also works most efficiently with 200 kv. and 4 ma. When this radiation is filtered through 0.48 Cu. and 2 mm. glass the effective wave-length is 0.165Å. The intensity, when measured at the surface of the mattress, coming from below, and after passing through 0.48 mm. Cu. and 2 mm. glass and 25 mm. mattress is 0.1517E, and at a depth of 10 cm., as measured on the paraffin block is 0.0561 or a percentage depth dose of 37.

Remarks. The Veifa and the International machines represent the usual type in use and are similar except that the Veifa has a "point" rectifying switch and the International a sausage-shaped rec-

tifying switch. When these two machines are measured by the same instrument under exactly similar conditions in the same rooms, and excited by the same primary current, and even run simultaneously, the output is practically the same in intensity and depth value. The surface and the depth dose will therefore be the same.

Attention is called to the observations previously described in the preliminary paper by one of us (Pfahler) as to the influence of the size of the field upon the surface dose, as well as the depth dose. As an example, on the Rieber machine with 210 kv., 4 ma., 0.48 Cu., 2 mm. gl. at a distance of 42 cm. and at the surface of a water-phantom the relative value of the radiation is as follows:

Size of Field in Cm.	At Surface, Per Cent	Erythema Dose, Min.
8 × 12	76	62
12 × 16	100	47
16 × 20	105	45
25 × 25	114.5	41

CONCLUSIONS

1. In interpreting the dose values as used by one author or another, one must know not only the voltage, the milliamperage, the filter and the distance but also the type of machine used, if the indirect method of measurements is employed, and we should be cautious in interpreting the value of an unknown machine.

2. The size of the field of radiation influences not only the depth dose but also the surface dose.

3. If one of the direct methods of measurements is referred to one should know its type and also its accuracy. Careful tests of a new instrument as it comes from the manufacturer should be made, before depending upon it for clinical work.

DISCUSSION

Dr. E. C. Ernst, St. Louis, Mo. Mr. President, I think the comparisons which Dr. Pfahler made are certainly valuable. I regret only that he didn't have a disc type of rectification machine to compare. I believe none of them were of the disc type. Perhaps all of those factors must be taken into consideration to a certain extent. The question of variations in different types of machines is rather a delicate point, particularly that difference between the Rieber type and the Veifa type. Showing how they can be used to produce the same results is certainly a most valuable contribution. Theoretically that would have seemed to be the case from the measurements that have been made.

The question of surface radiation, the size of the field, changing the superficial skin iontoquantimeter measurement radiation is likewise a point that must always be taken into consideration. The point that I would particularly like to emphasize is the manner of the use of the iontoquantimeter. We all realize the many fallacies and possible dangers in its use, but after all, Dr. Pfahler's work has been by means of such a machine.

My experience with the iontoquantimeter has been that if it doesn't work well there is no need of trying to repair it. After all the iontoquantimeter has peculiarities such that if one small part or another is not made correctly it will read wrong. For the past year and a half we have made use of one particular type, the Reiniger, Gebbert and Schall. After two to three months of careful observations we finally corrected all the possible errors, and have the machine in a place where it is never moved, nothing is changed and measurements can be made at will. Previous to the treatment of every patient, a preliminary reading is made as a rule, sixteen and a half to seventeen seconds is the necessary time required for the gold leaf to pass from one section on the scale to another).

Now we use a transformer practically all day long, and every ten days to two weeks we find that some part of the machine is not as it should be, and we immediately note a slight variation in the superficial intensity. Approximately three times a day we also make a depth-dose reading; and you can readily see if you have made your early measurements with an iontoquantimeter and with the help of a physicist and established that type of an intensity, that you can duplicate it, and you know when you are not duplicating it. To me the value of the iontoquantimeter is that with the aid of a physicist we can regulate our instrument and reduplicate those observations from time to time.

Dr. G. W. Grier, Pittsburgh, Pa. Dr. Pfahler's paper emphasizes a point that I feel all of us have met. That is that we are depending for something very important and vital on measurements of apparatus about which we don't know as much as we should. I believe Dr. Shearer was right when we first began talking about the ionization chambers in stating that the average doctor is not competent to make accurate readings with this instrument. But

I still believe that use of the iontoquantimeter is the most accurate method we have of determining dosage.

Now what I believe is that no machine should be used until the dosage has been measured properly. But I believe it should be done by someone skilled in the use of that instrument. Our experience with the Friedrich Iontoquantimeter has really been very satisfactory. We have not given 100 per cent dosage as measured with that instrument. We have found that 90 per cent of the dose as thus measured gives quite an erythema, of which the patient complains, but not seriously.

Now we know from experience that the dose as measured with the Friedrich instrument is the limit and the dose indicated with another instrument has been practically 100 per cent more or double that dose. If we gave the dose as measured by the second instrument on faith as represented to us by those who sell it we would be in serious trouble. We need to be guided by common sense and not accept readings of instruments to take the place of medical knowledge.

I would like to ask Dr. Pfahler a question. If we would use the factors with which we are familiar, that is, the voltage as measured possibly by a sphere gap and the milliamperage, the time, distance and filter, and use them after a dose has been decided with the use of some of these instruments of precision in the hands of some one skilled, would we not be better off than if we tried to use an iontoquantimeter, for instance, ourselves, as a measure of the dosage?

Dr. Henry Ullmann, Santa Barbara, Calif. I have had about two years' experience with an iontoquantimeter. Those of you who are just starting out or are having considerable trouble with such an instrument might be glad to know of the difficulties you may encounter. In most of the instruments the lead in wire passes through sulphur or paraffin. I have had to take the conducting tube apart twice, remove the sulphur and repack it, because of leakages due apparently to some chemical change occurring on the surface of the sulphur blocks. There was a discoloration. I didn't go any farther than that, but simply drilled it out and recased it.

Another thing: At first I wanted to be sure that I was using it as do physicists, who have given us certain standards. Therefore, I attempted to use tests that had already been published. I soon found that it took a number of hours of observations and then an averaging of them to come anywhere near the figures given in the literature. When this was done they tallied very closely. My last set of measurements, which involved only the reading between the surface and one point at the depth with one standard field, required over five hours. The first observations did not tally with the published tables, but after averaging this large series of observations they were found to check.

So do not accept your first readings on any machine or with any instrument, but take a great many on different days and then take your average.

Dr. O. Glasser, Cleveland, O. I was very sorry to hear about Dr. Pfahler's experience with the Friedrich iontoquantimeter, inasmuch as six years ago I started with Dr. Friedrich to build his instrument and we did quite a lot of measurements in that time. After all this experience in six years, knowing all about the instruments of dosage, I must say it is hard to use the instrument ordinarily in the office. It is possible, as Dr. Ernst said, if you have the instrument in a fixed position and you know all the factors, the influence of atmospheric conditions and all those things, it is possible, after an experience of some months, to use the instrument satisfactorily.

Dr. Pfahler said that the Friedrich instrument showed a leakage of first twenty minutes and then twelve minutes. If this is the case, the instrument cannot be used at all and should be returned. Friedrich iontoquantimeters under normal conditions show a discharge in about twelve or fifteen minutes, and to handle a natural leak of twenty minutes together with this is impossible.

As Dr. Ullmann said, usually the bad insulation is the cause of this trouble and should be replaced. But I think it is impossible to judge an instrument according to observations, for Dr. Ernst and many of you have had satisfactory experience with the iontoquantimeter. I would like to mention that most of the investigations of depth doses in this country are really made with ionization chambers like Friedrich's, constructed at home, and with any kind of electrometer connected with this ionization chamber.

The Duane arrangement is a very satisfactory instrument, but it also has certain difficulties. I mentioned in Atlantic City that the large ionization chamber, and especially that one constructed of aluminum, sometimes gives rise to difficulties in measuring.

I had a letter from Professor Duane a few weeks ago in which he stated that he measured this depth dose again and got a higher depth dose of 46 or 47 per cent. This agrees very well with the measurements made by other physicists in this country.

It is not so important what instrument is used as it is to measure correctly absolute units, and to use the right depth and quantity distribution charts for these measured conditions.

DR. PFAHLER (closing discussion). First of all I want to make it quite clear that I am not condemning any iontoquantimeter, much less Professor Friedrich's. There was no intention of that, and I am very much afraid that I left that impression. What I do want to say is that you must not get one of these instruments and then on the faith of the reading go ahead and give a dose, for you are apt to do a great deal of harm either in giving too much or too little. Something may happen to the instrument to throw it entirely out between the time it leaves Professor Friedrich's, or any other laboratory, and the time it reaches your office; and yet to all outward appearances it may be in good condition.

Of course, we must use these instruments. Use the best you can get, but be cautious at the same time, especially if they differ with your clinical sense.

Dr. Grier asked if we could have a machine measured and then go ahead and use it with observations upon the indirect elements. I believe that, generally speaking, that is the best thing for us to do. There will be variations from time to time due to some fault in the machine, dirt, leakage, or something else; but you will be very much more accurate than if you attempt to use some of these scientific instruments casually and perhaps with insufficient training.

Now I believe, too, with what Dr. Ullmann has said, that we will be much more nearly accurate if we take great averages. But the mere fact that those great averages are required, and that there is a great variation from hour to hour, in my judgment, casts sad reflection upon the measuring instrument, the installment, or something else. You don't treat a patient by averages; you don't treat a patient this hour and then for six hours and the next day for six hours and then strike an average; the dose you are giving during this hour and the next hour is the one that affects the patient. I believe that the nearer we can measure the output during a particular hour, or a particular period of time, the more accurate our work will be.

I think that answers all the questions. I want it quite clear that I am not condemning the iontoquantimeter of any make, much less that of Professor Friedrich.

THE EFFECTS OF THE SHORTER WAVE-LENGTH ROENTGEN RAY ON THE GASTRIC SECRETION OF DOGS*

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THE purpose of this paper is to give a preliminary report of experiments made to determine the effects, on the gastric secretion of dogs, of the high voltage roentgen rays of short wave-length as applied therapeutically. Further work is in progress to substantiate and amplify the results thus far obtained.

Gastric secretion has been studied by various observers after direct exposure over the stomachs of animals, using the long wave-length rays, but no one, as far as we can find in the literature, has studied the effects of the shorter wave-length therapy; nor has any one studied the effects on the gastric secretion after exposure over the chest and over the lower abdomen, excluding the stomach in each case.

A review of the literature shows that Winternitz,[1] in 1910, found that radium in even relatively large doses, in radioactive water, had no influence on gastric secretion. Regaud, Nogier, and Lacassagne,[2] in 1912, found that the glands of the fundic portion of the stomach had undergone complete atrophy in a dog which had been exposed to a total of 63 Holzknecht units (3 doses of 9 H with 2 mm. of Al. filter, 1 dose of 14 H with 3 mm. of Al. filter and 1 dose of 22 H with 4 mm. of Al. filter) given in 5 doses over a course of fifteen months. They made no observations on the gastric secretion of this dog. Bruegel,[3] in 1916, in a report covering 90 cases, stated that the acidity of gastric secretion is reduced after exposure to 16 to 20 H, using a

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filter of 3 mm. Al. and 1½ cm. of hard rubber and a 30 cm. focal skin distance. He administered 4 to 5 H anteriorly and posteriorly over the stomach, and in fourteen days repeated the dose. He attempted to stimulate the gastric glands in cases of hypo- and anacidity by using stimulating doses of roentgen ray, but had negative results. Wilms,[4] in 1916, stated that in certain cases of pylorospasm, the roentgen ray had given some relief, which he attributed to the lowering of gastric acidity. Stephan,[5] in 1920, reported that a case of achylia gastro-pancreatica had, on being irradiated, shown some improvement in the pancreatic deficiency, but no change in the achylia. Bryan and Normody,[6] in 1921, reported 2 cases in which they reduced the gastric acidity approximately 40 per cent. Their technique was 25 ma. min., 80 kv., 3 mm. Al. filter, skin target distance 10 in., exposed over the stomach regions.

Wachter,[7] in 1921, reported a series of experiments. The gastric acidity was in each case previously determined; on the following day a quarter of a skin-unit dose was given in ten minutes' time through a 4 mm. Al. filter. On the fourth day the gastric acidity, after a test meal, was again determined, and on the two following days the same dosage of roentgen ray was given. Then on the seventh day, another determination of gastric acidity was made. In only a few instances, after a three weeks' interval, were two more doses given. Twice the full skin-unit dose was given through a heavy filter at one sitting, but only with the same effect as secured from the divided doses. In 8 cases with normal HCl content there was a decrease, especially marked for the free HCl. In 2 cases of gastric neurosis with normal HCl content, there was an increase of HCl after two sittings, or the opposite of the rule. Four cases of hyperacidity reacted without exception with a decrease affecting the free and the total acidity in constant ratio. In an old case of gastric ulcer, the decrease of HCl was secured only after four doses. In cases with no free acidity and a trifling or medium amount of total acid, the total acidity was only once somewhat decreased. Several cases remained uninfluenced. In 4 cases with gastric neurosis, the radiation apparently acted as a stimulus, free acid appearing in each case, the total acid twice rising and twice falling. In the last two instances, the stimulating dose was apparently exceeded, resulting in depression. In 2 cases which had long been treated with 10 minims of hydrochloric acid t.i.d., without the appearance of free acid in the gastric contents, radiation coincident with the giving of hydrochloric acid resulted in a rapid appearance of free HCl. Secondary symptoms, such as vomiting, pain in the stomach and back, diarrhea, boring and sticking sensations in the stomach region, were usually transitory and did not prevent further treatments with radiation. In one case of tuberculous heritage, a continuous temperature of 40°C. or 104°F. for two weeks precluded further dosage. This author assumes this to be due to activation of retroperitoneal foci.

Seego and Rother,[8] in 1921, made a gastric fistula on a dog and also an esophageal fistula. During the experimental periods, the dog would eat food which passed through the esophageal fistula instead of into the stomach. The gastric secretion excited by the act of eating was obtained free of food substances by this method of pseudo or apparent feeding (Scheinfuetterung). They then radiated the animal, the first two treatments being the common therapeutic doses from the front, resulting in no apparent changes whatever in the gastric secretion. The third and fourth were above the therapeutic dosage, were very heavy, and resulted in a juice with increased HCl and pepsin, and especially of a much higher rennin content than normal; each time, however, this supranormal period was followed by a shorter period of decreased gastric secretion. The fifth radiation was enormous and of fatal dosage; the animal, following this, became dull, apathetic, without appetite, and unfit, of course, for a further Scheinfuetterung, except that shortly before he was killed, a feeding of raw horse flesh resulted in securing some gastric juice, poor in ferment, the anacidity being ascribed by the author to neutralization by duodenal regurgitation of alkaline content.

From this work of Seego and Rother, it does not appear likely that there would be any success in the treatment of hyperacidity by radiation, or any possibility of lessening the acid secretions of the stomach by small therapeutic doses, or that the gastric secretory function could be stimulated by any dose which would come into consideration. The conclusion may be drawn that gastric glandular tissue is stimulated by very large doses of roentgen rays, the stimulation being followed immediately by a shorter period of depression of function, from which, however, the stomach quickly recovers its normal condition.

Lawrence,[9] in 1922, concluded that the effect of radiation on enzyme action, as determined by Wohlgemuth's diastase test, is extremely slight and of no particular importance.

Warren and Whipple,[10] in 1922, found that in a dog, a unit dose of 350 ma. min. given over the thorax with the abdomen shielded, caused no clinical disturbance. A subsequent exposure of the same unit dose in the same dog, given over the abdomen with the thorax shielded, caused fatal intoxication and death in four days. They found the stomach more resistant than the small bowel.

Miescher,[11] in 1922, working on a dog with the Pawlow stomach, found that with heavy dosage he decreased the secretion of acid and increased the secretion of the rest of the gastric constituents, including pepsin. This phenomenon began on the third day following radiation, reached its maximum on the tenth day, and returned to normal in about two and a half months. Doses of equal intensity were given at three weekly intervals, resulting in almost complete suppression of all the gastric secretions, but with an unexpectedly rapid return of normal function when the radiation stopped. The pepsin curve behaved differently from both the acid curve and the curve of the other components of gastric juice, not sinking until the others began to rise again. This suggests that the different constituents of gastric juice have a certain independence and represent functional mechanisms on which radiation does not act in a similar manner. The quick recovery following the repeated radiations suggests that under certain conditions the sensitiveness of an organ by radiation may diminish.

Ivy[12] and his co-workers have recently shown that small doses of roentgen rays cannot stimulate the secretion of the submaxillary gland of a dog and that heavy doses suppress its secretory activity. The latter doses were two dog erythema doses or five human erythema doses. They found the dog skin 2½ to 3 times less sensitive than human skin, which coincides with the observations of Martin and Rogers,[13] who found that the dog's skin is 3 times less sensitive than the skin of man. The latter observers also found that the minimum erythema dose of the dog's skin when applied directly to the dog's intestines, produces hyperemia, marked contractions in all directions, and destruction and desquamation of the mucosa.

Simonetti,[14] in 1923, concluded from his experience on 11 patients that stimulating doses of roentgen rays over the stomach (he does not give the dose) are, in a majority of cases, accompanied by an increase in the free and total acidity and also peptic activity. It may occur the same day or sometimes a day or two later.

Roth and Morton,[15] in 1923, found that there was no definite effect following the radiation of pepsin solutions. The slight variations they noted would fall within the limits of experimental error.

Ivy and his co-workers, in a recent article, found that the gastric glands are not stimulated by small doses of roentgen rays, that a dosage of 110 kv. min., 5 ma. min., 30 cm. f.s.d., 1 mm. Al. filter, 6 cm. diameter portal for one hour, which amounts to from 160 to 170 per cent of a dog's erythema dose, causes hyposecretion and achylia and marked reduction in the pepsin secretion, mucus only being secreted; that the acid curve was affected before the pepsin; and that after three to four weeks the gastric secretion returns to normal acidity, but is reduced permanently in quantity; and finally that the chlorides of gastric secretion are not especially altered by roentgen rays.

METHODS

In our work the so-called Pawlow pouch was used. In this method, a portion of the stomach is isolated, with the blood and nerve supply intact, and opens to the outside, so that the gastric juice can be collected and studied (Fig. 1). Two to four

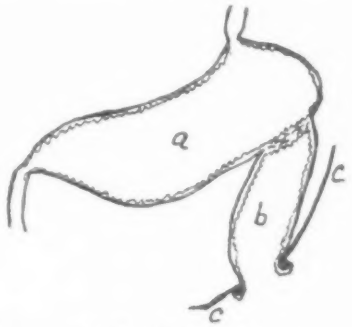

FIG. 1. Diagram of a Pawlow pouch, or accessory stomach, with nerve and blood supply intact. a, the main stomach; b, the Pawlow pouch; c, the abdominal wall.

weeks elapsed after the operation of making the pouch, before the animals were used for experimentation. Control experiments were made, in which the gastric secretion was collected for one hour before the test meal was given, and the secretion was then collected hourly for four hours following the meal. The meal of the dog consisted of 200 gms. of raw meat, 50 of toast or bread, and 250 c.c. of milk. During all the experiments the dogs were given a bone to chew on twice a week. The hourly secretions were measured in amount, titrated for free and total acid with 40 per cent sodium hydroxide and later reduced to degrees of $\frac{1}{10}$th normal, in which form the readings appear on the charts; peptic activity was determined by means of Mett's method. No chloride determinations were made.

With Dog No. 1, the daily secretions were collected for fourteen days, after which exposure was made for one hour for three days in succession, over the chest, excluding the stomach. The juice was then collected for three to four weeks and the same dose was repeated over the lower abdomen, at this time also excluding the stomach. Three weeks again elapsed and the dog was then exposed to the same dose for three days, the exposure being limited to the region of the stomach.

With Dog No. II, the same control method was used. The first exposure was a continued dose of three hours in one day over the chest, excluding the stomach. Three weeks later, this dose was repeated over the chest, the stomach being again excluded. Four weeks later the same dose was repeated over the lower abdomen, also excluding the stomach. Finally four weeks later, the region of the stomach was irradiated, using the same number of units. Following each exposure, the animal was given the test meal, after the fasting juice has been collected, as previously described.

TABLE I

CHANGES IN THE ACIDITY AVERAGED FOR THE DIFFERENT PERIODS FROM THE MAXIMUM DAILY FIGURES FOR EACH PERIOD

	Dog I			Dog II		
	Procedure	Free HCl	Total Acidity	Procedure	Free HCl	Total Acidity
A	Normal (11 days)	96	113.1	Normal (21 days)	81	100.4
B	Exposure over chest (3 days)	80	99.1	Exposure over chest (1 day)	112.5	137.2
C	Next 11 days	95	115.2	Next 11 days	102	112
D	Next 5 days	84	101	Next 5 days	73	89.9
E				Exposure over chest (1 day)	107.5	120
F				Next 23 days	78	93
G	Exposure over lower abdomen (3 days)	82	96.3	Exposure over lower abdomen (1 day)	93	105
H	Next 21 days	45	70.6	Next 23 days	41	68
I	Exposure over stomach (3 days)	73	88.1	Exposure over stomach (1 day)	30	80
J				Next 4 days	65	91
K	Next 21 days	32	50.9			
L	Next 28 days	0	18	Next 14 days	7	21

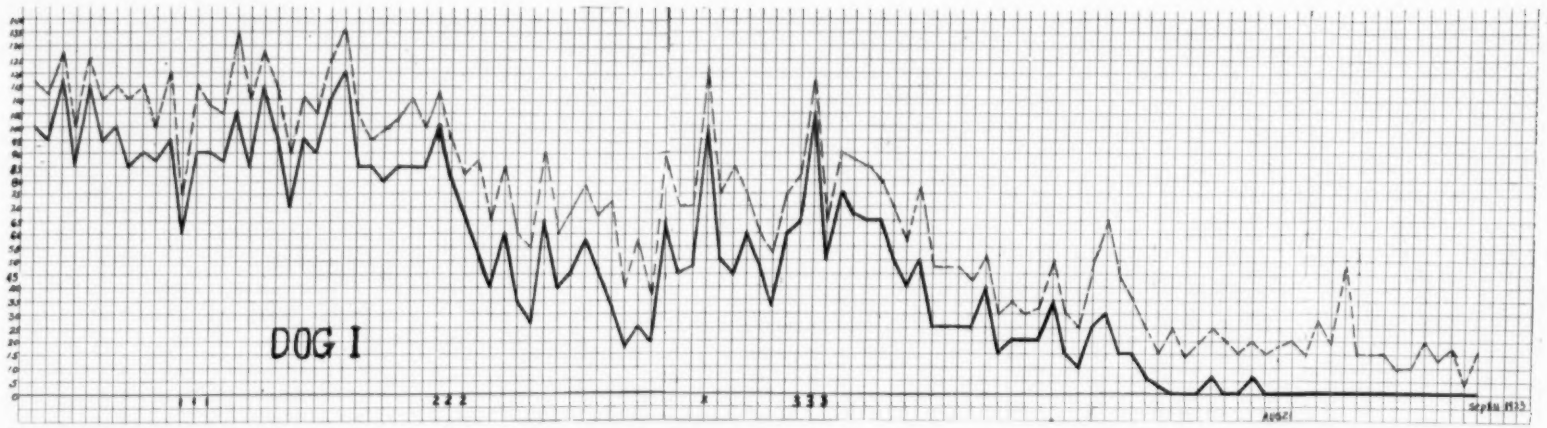

CHART A. Daily variation in the free hydrochloric acid and total acidity of Dog I indicating the maximum single titration for each day. 111, exposure over chest (3 days); 222, exposure over lower abdomen (3 days); 333, exposure over stomach (3 days). X, marked fall of outside temperature (20°).

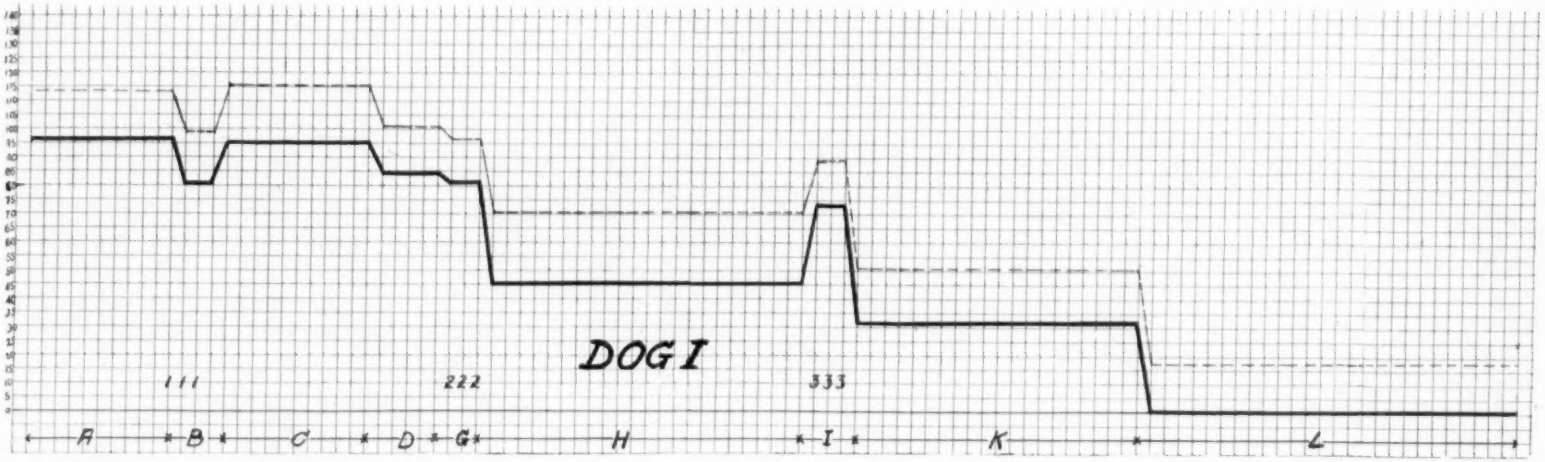

CHART B. The mean of the maximum daily variation of Dog I for the following periods: A, normal 11 days; B, exposure over the chest 3 days; C, next 11 days; D, next 5 days; G, exposure over the lower abdomen 3 days; H, next 21 days; I, exposure over the stomach 3 days; K, next 21 days; L, next 28 days.

In this way, we were able to study the effect of our unit dose of roentgen ray on the gastric secretion both before and during digestion, after the exposure over the various anatomical regions.

The roentgenologic technique was as follows:

Skin-target distance.... 55 cm.
Tube voltage..... 200,000 volts
Tube current..... 6 ma.
Filter..... 0.78 mm. Cu. over 1 mm. Al.
Energy delivered to the skin per hour is 600 "e" units.
Penetration: As measured in paraffin, intensity at 10 cm. depth is 46 per cent of surface intensity.

Dog No. I

5–15–23 1 hour, field 14 cm. × 14 cm. over the chest, just above diaphragm.
5–16–23 1 hour, field 14 cm. × 14 cm. over the chest, just above diaphragm.
5–17–23 1 hour, field 14 cm. × 14 cm. over the chest, just above diaphragm.
6–6–23 1 hour, field 14 cm. × 14 cm., over lower abdomen.
6–7–23 1 hour, field 14 cm. × 14 cm., over lower abdomen.
6–8–23 1 hour, field 14 cm. × 14 cm., over lower abdomen.
7–11–23 1 hour, field 14 cm. × 14 cm., over the stomach, pouch at center of field.
7–13–23 1 hour, field 14 cm. × 14 cm., over the stomach, pouch at center of field.
7–14–23 1 hour, field 14 cm. × 14 cm., over the stomach, pouch at center of field.
Dose: 600 "e" units per hour.

Dog No. II

5–29–23, 3 hours, field 14 cm. × 14 cm. over chest (1800 "e" units).
6–19–23, 3 hours, field 14 cm. × 14 cm. over chest (1800 "e" units).
7–17–23, 3 hours, field 14 cm. × 14 cm. over lower abdomen (1800 "e" units).
8–21–23, 3 hours, field 14 cm. × 14 cm. over stomach (1800 "e" units).

It will be noted that this is the same technique used for human therapy and no recognition is taken of the fact that the skin of the dog is one-third as sensitive as the skin of man.

In Dog No. I, giving the divided doses over the chest had little, if any, effect, except that of slight stimulation (Chart A and B and Table I). It is to be noted that after each exposure over the chest, there was an increase of gastric function above the level of the previous day. After the exposure over the lower abdomen, avoiding the stomach, there was a marked decrease in the free and total acidity. Only once during this period did the curve reach anywhere near its former height; on that day there was a drop of outside temperature of over 20°F., which may have had some effect on these dogs. Immediately following radiation over the region of the stomach, it is to be noted that the acids again reached the level of the control period, but from that day on there was a gradual drop to achylia or to almost complete achylia.

In Dog No. II following the first massive dose over the chest, the gastric secretion was stimulated for a period (Charts C and D and Table I). We therefore repeated this dose over the chest to see if we could again get the stimulatory effects, but during the latter experiment, the curves did not rise as high as after the first exposure. After the dog had been treated over the

TABLE II

TO SHOW THE HOURLY VARIATION IN THE ACIDITY AND PEPTIC ACTIVITY IN A SINGLE DAY CORRESPONDING TO THE DAILY VARIATIONS GIVEN IN TABLE I

Dog I

	Procedure	Free HCl	Total Acidity	Peptic Activity
A	Normal			
	Fasting 1 hr.	10	23	5.87
	Meal 1st hr.	50	70	4.12
	Meal 2nd hr.	85	105	4.32
	Meal 3rd hr.	95	110	3.82
	Meal 4th hr.	80	100	3.56
B	Exposure over chest			
	Fasting 1st hr. before x-ray	0	27	1.62
	Fasting 1st hr. after x-ray	0	25	2.18
	Meal 1st hr.	65	77.5	4.00
	Meal 2nd hr.	90	107.5	3.75
	Meal 3rd hr.	82.5	95	4.12
	Meal 4th hr.	65	77.5	3.12
C	After chest exposure			
	Fasting 1st hr.	12	20	3.62
	Meal 1st hr.	82.5	95	5.87
	Meal 2nd hr.	92.5	110	6.66
	Meal 3rd hr.	90	106	5.00
	Meal 4th hr.	40	55	3.62
D	Next 5 days			
	Fasting 1st hr.	10	30	3.5
	Meal 1st hr.	55	77.5	4.5
	Meal 2nd hr.	85	95	5.3
	Meal 3rd hr.	80	95	4.8
	Meal 4th hr.	75	100	3.5
G	Exposure over lower abdomen			
	Fasting 1st hr.	25	40	6.51
	Fasting 1st hr. after x-ray	40	70	8.41
	Meal 1st hr.	70	87.5	7.25
	Meal 2nd hr.	85	100	4.25
	Meal 3rd hr.	80	100.0	3.82
	Meal 4th hr.	84.2	102.5	4.16
H	Next 21 days			
	Fasting 1st hr.	0	25	4.25
	Meal 1st hr.	0	25	5.00
	Meal 2nd hr.	32.5	57.5	3.50
	Meal 3rd hr.	45	70	2.75
	Meal 4th hr.	35	62.5	2.75
I	Exposure over stomach			
	Fasting 1st hr. before x-ray	0	10	2.5
	Fasting 1st hr. after x-ray	5	29.5	2.5
	Meal 1st hr.	57.5	75	4.0
	Meal 2nd hr.	75	90	2.0
	Meal 3rd hr.	65	80	3.5
	Meal 4th hr.	57.5	75	2.0
K	Next 21 days			
	Fasting 1st hr.	0	125	1.0
	Meal 1st hr.	5	20	1.5
	Meal 2nd hr.	35	47.5	3.5
	Meal 3rd hr.	40	52.5	1.25
	Meal 4th hr.	22.5	37.5	1.5
L	Next 22 days			
	Fasting 1st hr.	0	5	.5
	Meal 1st hr.	0	5	1.0
	Meal 2nd hr.	0	8	.5
	Meal 3rd hr.	0	8	.7
	Meal 4th hr.	0	10	.9

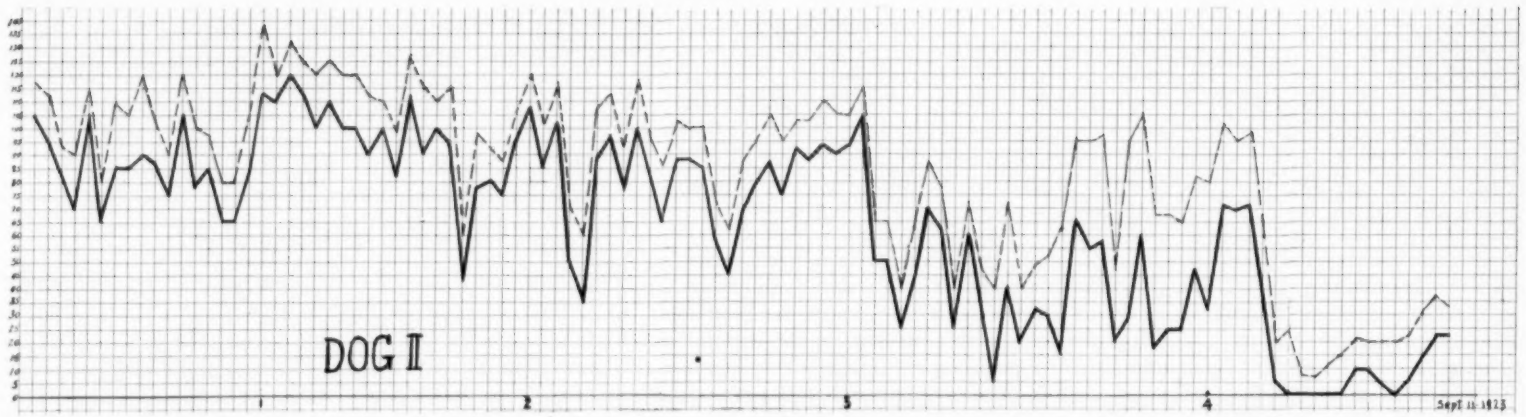

CHART C. The daily variation in the free hydrochloric acid and total acidity of Dog II denoting the maximum single titration for each day. 1, exposure over chest (1 day); 2, exposure over the chest (1 day); 3, exposure over the lower abdomen (1 day); 4, exposure over the stomach (1 day).

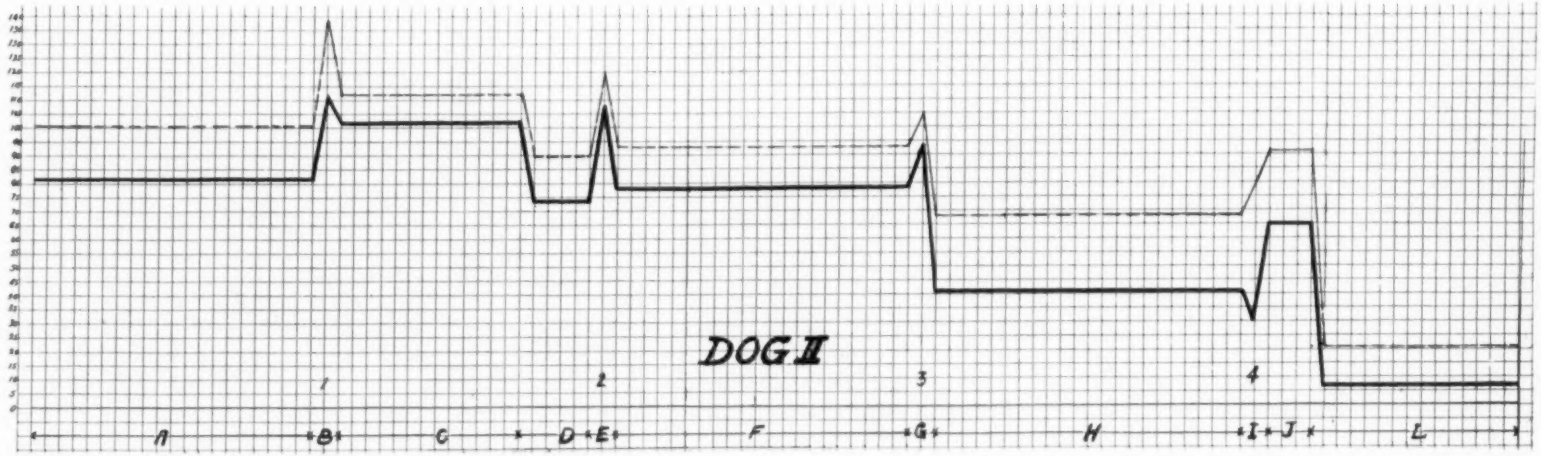

CHART D. The mean of the maximum daily variation of Dog II for the following periods: A, normal (21 days); B, exposure over the chest (1 day); C, next 11 days; D, next 5 days; E, exposure over the chest (1 day); F, next 23 days; G, exposure over the lower abdomen (1 day); H, next 23 days; I, exposure over the stomach (1 day); J, next 4 days; K, next 14 days.

TABLE III
Dog II

	Procedure	Free HCl	Total Acidity	Peptic Activity
A	Normal			
	Fasting 1st hr.	0	25	5.81
	Meal 1st hr.	45	60	9.1
	Meal 2nd hr.	75	100	5.75
	Meal 3rd hr.	85	100	4.37
	Meal 4th hr.	80	100	3.87
B	Exposure over chest			
	Fasting 1st hr. before x-ray	12.5	18	9.50
	Fasting 1st hr. after x-ray	62.5	92.5	8.00
	Meal 1st hr.	110	125	7.33
	Meal 2nd hr.	112.5	125	4.00
	Meal 3rd hr.	112.5	137.2	2.00
	Meal 4th hr.	105	125	2.00
C	Next 11 days after exposure			
	Fasting 1st hr.	0	25	5.83
	Meal 1st hr.	60	85	6.00
	Meal 2nd hr.	100	117.5	3.60
	Meal 3rd hr.	87.5	105	5.12
	Meal 4th hr.	100	120	2.87
D	Next 5 days			
	Fasting 1st hr.	0	7.25	4.00
	Meal 1st hr.	12.5	40	3.75
	Meal 2nd hr.	37.5	55	6.12
	Meal 3rd hr.	76.5	82.5	3.25
	Meal 4th hr.	80	92.5	3.00
E	Exposure over chest			
	Fasting 1st hr. before x-ray	10	15	5.00
	Fasting 1st hr. after x-ray	10	37	4.00
	Meal 1st hr.	62.5	80	5.00
	Meal 2nd hr.	77.5	92.5	4.00
	Meal 3rd hr.	105	120	5.00
	Meal 4th hr.	107	120	8.00
F	Next 23 days			
	Fasting 1st hr.	30	50	3.5
	Meal 1st hr.	42.5	62.5	6.75
	Meal 2nd hr.	62.5	77.5	8.00
	Meal 3rd hr.	80	95	4.00
	Meal 4th hr.	77.5	95	4.25
G	Exposure over lower abdomen			
	Fasting 1st hr. before x-ray	6	15	3.0
	Fasting 1st hr. after x-ray	0	10	3.25
	Meal 1st hr.	25	50	3.75
	Meal 2nd hr.	55	77.5	5.00
	Meal 3rd hr.	65	85	2.00
	Meal 4th hr.	93	105	3.0
H	Next 23 days after exposure			
	Fasting 1st hr.	15	30	2.5
	Meal 1st hr.	17.5	35	2.5
	Meal 2nd hr.	30	50	2.0
	Meal 3rd hr.	35	52.5	3.0
	Meal 4th hr.	45	65	2.5
I	Exposure over stomach 1st day			
	Fasting 1st hr. before x-ray	0	12	2.6
	After x-ray	0	6	3.0
	Meal 1st hr.	32	80	3.5
	Meal 2nd hr.	30	80	3.0
	Meal 3rd hr.	12	42	2.5
	Meal 4th hr.	15	21	2.5
K	Next 4 days			
	Fasting 1st hr.	38	56	1.5
	Meal 1st hr.	35	75	1.6
	Meal 2nd hr.	66	80	1.7
	Meal 3rd hr.	78	93	1.0
	Meal 4th hr.	76	98	1.0
L	Next 14 days			
	Fasting 1st hr.	0	7	1.82
	Meal 1st hr.	5	20	1.5
	Meal 2nd hr.	0	25	0.5
	Meal 3rd hr.	0	24	0.5
	Meal 4th hr.	5	23	1.0

lower abdomen with the massive dose, avoiding the stomach, there occurred a marked diminution in the free and total acidity. Following the treatment of the massive dose over the stomach itself, there was an even more rapid decrease in the free and total acidity, so that achylia or near achylia developed within a few days after the treatment. This effect is to be compared with that obtained in Dog No. I, in which, after the divided dose, it required a period of nearly two weeks to reach achylia or near achylia. The peptic activity of these dogs was affected very little, if any, by exposure over the chest and the lower abdomen, but it was diminished when the dogs were exposed over the stomach. The decrease, however, did not manifest itself until after the acid curve had shown a marked drop. Both dogs showed a slight diminution in appetite after the exposures. Dog No. II, which received the massive dose, showed a more marked decrease in appetite, but soon returned to normal after each exposure. Neither dog had lost appreciably in weight during the four months included in this series of observations. They were nearly as lively at the end of this period as they were before the experiments were begun.

From the results of these experiments, we infer that little, if any, damage is done to the gastric secretion of dogs when the latter are exposed over the chest to short-wave roentgen rays in such dosages as are usually applied therapeutically to human beings; that there is a marked lowering of both free and total acidity when exposure is over the abdomen; and that there is absence, or practically an absence, of free acid when exposure is directly over the stomach. If a dog's skin is one-third as sensitive as that of man, then we feel that it is justifiable to conclude that we ought to expect more marked changes in a human being who has been submitted to the same dose over the same period of time.

We are not at this time prepared to present the report of the pathological changes that have gone on in these animals; these changes will be embodied in our later report of the work.

CONCLUSIONS

1. The human dosage of the shorter wave-length roentgen-ray therapy, when applied over the chest of a dog, has little or no effect, except a transient stimulation of the gastric secretion.

2. Gastric acidity is markedly lowered when the exposure is over the lower abdomen below the stomach.

3. Achylia or near achylia is produced when the stomach itself is exposed.

4. More damage will probably be done to human gastric glands, using the same

dosage and the same technique, than was noticed in these animals.

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ROENTGEN-RAY CACHEXIA*

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DALLAS, TEXAS

ONE of the most serious of the ill effects of intensive radiation as described in the foreign literature appears to be the so-called "roentgen cachexia" which comes on slowly and produces great emaciation. Opitz,[1] in discussing the effects of radiation, states that he believes that certain chemical substances are elaborated in the body which produce the well-known treatment sickness followed by irreversible blood changes and later by cachexia. The cachexia which occurs in dogs following the exposure of a loop of small intestine to a large dose of *x*-rays was described in a previous paper.[2] This slow emaciation appeared to resemble the clinical syndrome so closely that a more elaborate investigation was decided upon.

Even though these clinical and experimental conditions may not have the same etiology, a more detailed study of intestinal reactions following radiation should be taken up in an effort to correlate some of the conflicting evidence now appearing in published articles. There seems to be little agreement as to the actual tolerance dose for the intestinal mucosa. Schmitz[3] states that "the maximum dose that the vesical and rectal mucosae will bear without injury is 130 per cent of an E. S. D." Wintz claims that 135 per cent of an erythema dose is safe. In the face of these statements Fried[4] describes fully the autopsy findings in a case of carcinoma of the cervix that showed a rupture of the entire sigmoid which occurred following the application of 128 to 138 per cent of an erythema dose to this structure. Muhlmann and Meyer,[5] after describing the intestinal ulcers that may be produced by overradiation, give the toxic dose for the intestine as 160 per cent of the skin dose. Wintz[6] describes small ulcers that occurred in the posterior rectal wall in some of his thin patients treated over the pelvis, but states that these lesions were produced by 140 to 150 per cent of the erythema dose, which unavoidably reached the affected regions. In all probability such discrepancies are due to errors in measurement rather than to any great variation in the susceptibility of the intestine. The erythema skin dose as judged by different workers is subject to considerable variation and makes a most unsatisfactory unit where an error of 10 per cent may lead to serious ill effects. The many types of ionization apparatus in use can hardly be expected to give identical readings, and until some standard device is adopted ionization measurements will undoubtedly vary somewhat.

The determination of the intestinal tolerance dose is of great importance since certain malignant tumors occurring in the abdomen appear to be more resistant to radiation than the mucosa itself, and in such cases efficient treatment might prove disastrous to the patient. Thus Fischer[7] describes three autopsied cases in which histologically normal carcinomatous tissue was found at the site of intestinal necrosis produced by intensive radiation. Any safe treatment in such cases would apparently have been of no avail. The possibility of damaging the intestine was brought out

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as early as 1912 by Regaud, Nogier, and Lacassagne,[8] who studied the effect of cross-firing the abdomen in dogs.

Since we had no proven measuring apparatus at our command it seemed unwise to attempt a study of intestinal sensitiveness. However, it was possible to investigate the various types of injury produced in the intestine, and special attention was given to the end results.

FIG. 1. Dog No. 1 one week after the operation during which a loop of small intestine received a "dog erythema dose."

Warren and Whipple[9] have described a rapid death in dogs occurring four days after radiation of the whole abdomen with doses large enough to produce destruction of the intestinal epithelium. Denis, Martin and Aldrich[10] applied approximately ⅔ of this dose to single large areas over the abdomen in rabbits and produced a rapid cachexia leading to a fatal outcome in three or four weeks. No marked gross lesions were observed in the intestines of these animals. These experiments seemed to indicate a variation in the length of life depending upon the size of the dose used when large abdominal areas were exposed. In order to examine this point, five young guinea-pigs of about the same age were placed on an animal board one after another and radiated over the entire abdomen. Each animal was secured on the board with the abdomen uppermost and a shield was placed over the head and upper thorax. A 9-in. parallel gap was used at a 10-in. focal skin distance with a filter of 2 mm. of aluminum. The doses administered were 200, 152, 100, 72 and 56 ma. min. The first three animals became very weak, developed a mucous diarrhea and died in six days. The pig receiving 72 ma. min. developed a diarrhea and a rapid cachexia, but lived three weeks. The animal receiving 56 ma. min. was watched for a month, during which time no ill effects were observed. These findings indicate that death is not produced by radiation of the whole abdomen until a certain threshold

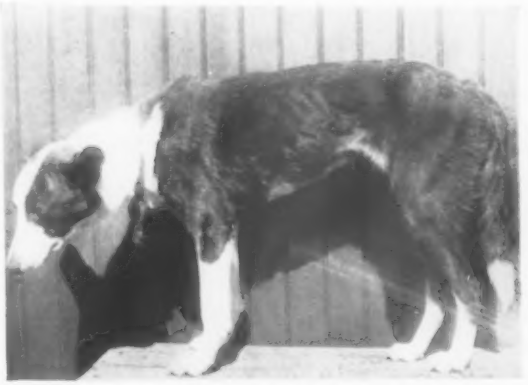

FIG. 2. Dog No. 1 fifty-three days after the radiation of a loop of small intestine.

value is reached. When such a dose is administered death occurs only after a fairly long period characterized by emaciation and diarrhea. If the dose be increased still more, a rapid death occurs a few days after the raying is done. The latent period of six days which preceded death was not shortened by a marked increase in the dose.

In actual practice it is unusual to apply large doses to the whole abdomen, and therefore it seemed best to study their effects on single loops of intestine. In a previous paper,[2] the effect of the erythema dose for a dog upon an isolated loop of small intestine was described in detail. A dose of 75 ma. min. applied at a focal skin distance of 10 in. with a parallel gap of 5 in. and no filters was just sufficient to produce a reaction on the dog's skin. The human erythema dose is, of course, much

smaller, but since it was our desire to study the severe reactions this dose was adopted. In our previous article attention was called to the fact that the administration of this dose to a single loop of small intestine caused no symptoms at the end of three weeks although the mucosa showed almost complete destruction at that time. The lack of symptoms made it seem imperative to study such animals over longer periods of time. Six dogs were, therefore, operated upon in the roentgen-ray laboratory, and in each instance a dose of 75 ma. min. was administered to an isolated loop of small intestine varying from 10 to 15 in. in length. The loop was brought through a small hole in a lead shield so that no other structures were rayed. One animal died of peritonitis two days following the operation and a second dog died of infection at the end of a week. The other four recovered promptly and were in good condition at the end of three weeks, at which time they appeared perfectly normal and had good appetites. Figure 1 shows the appearance of Dog No. 1 seven days after the operation. This animal did well for thirty-two days, but at the end of that period its appetite began to fail, and it seemed to be losing weight. A distaste for food seemed to develop and the weight loss became progressive until at the end of fifty-three days the animal was quite emaciated. Figure 2 shows its condition at that time. Since the lesion causing this syndrome was sharply localized it seemed reasonable to assume that resection of the affected loop might lead to recovery. An operation was done immediately. The diseased loop was resected and an end-to-end anastomosis done. The appearance of the opened resected loop is shown in Figure 3. Large ulcers showing a greyish-green necrotic surface were found along one side of the intestine. The intestinal wall was much thickened but there was no evidence of obstruction to be seen. For three days the outlook appeared bright, but on the fourth day the dog began to look sick, and on the eighth day death occurred. An autopsy revealed a peritonitis apparently secondary to a leak in the end to end anastomosis. The failure of this experiment was unfortunate, since we had hoped to demonstrate a successful method of treating isolated lesions.

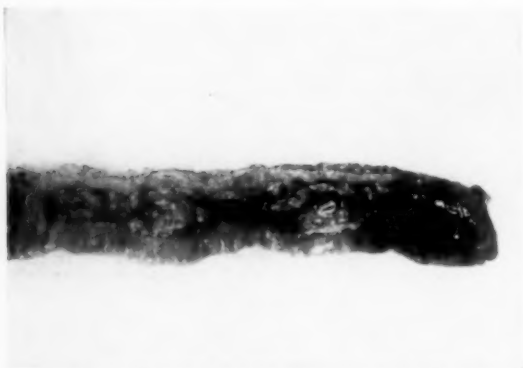

FIG. 3. Opened loop of small intestine from Dog. No. 1 removed fifty-three days after the radiation.

FIG. 4. Dog No. 5 fifty-eight days after the administration of a "dog erythema dose" to a loop of small intestine.

Dog No. 5 appeared to be doing well for a month following the operation but at the end of thirty-four days it showed a distaste for food and seemed to be losing weight. The emaciation soon became quite pronounced. Figure 4 illustrates the condition fifty-eight days after radiation. On the sixty-fifth day the animal was found dead. At autopsy the affected loop showed shallow ulceration of the mucous surface, with a thickening of the intestinal wall, but again there was no evidence of obstruction visible.

Dog No. 6 passed through almost identically the same stages as dog No. 5. On the sixty-fifth day the photograph

shown in Figure 5 was taken. The animal was in such poor condition at this time that it was sacrificed. An autopsy revealed the characteristic ulceration as previously described. The appearance of the opened loop is shown in Figure 6. Here again no evidence of obstruction was observed.

Dog No. 4 proved to be the most interesting one of the series. This animal was an excellent specimen and remained in unusually good condition for a month following the operation. At the end of forty-one days emaciation became noticeable to a slight extent and food was taken sparingly. At the end of fifty-eight days the photograph shown in Figure 7 was taken. The dog seemed to be going down hill just as the others had done. Soon afterward it began to take more food and showed definite improvement. This improvement was progressive and it seemed that recovery was assured. Figure 8 shows the improved general condition one hundred and seventeen days after the operation. Soon after this photograph was taken the animal began to grow thin and rapidly became very much emaciated in spite of the fact that it still took food very freely. Figure 9 illustrates the advanced cachexia as it was observed one hundred and sixty-three days after the radiation. In spite of the marked loss of weight the dog was still strong enough to fight with the other dogs for its food, and ate ravenously. On the one hundred and sixty-sixth day autopsy was decided upon. When the abdomen was opened a moderate amount of clear straw-colored fluid was observed in the peritoneal cavity. The small intestine above the radiated region showed marked dilatation. The diameter of the lumen in this region was at least five times that of the normal intestine. This dilatation ceased abruptly in an indurated strip which was markedly contracted and did not measure over 1½ in. in length. The loop originally exposed was 13 in. in length. The contracted strip was markedly indurated and could be compressed very little with the fingers. The intestine below the exposed loop appeared perfectly normal. A considerable amount of fecal material was observed in the lower bowel and rectum. The appearance of the involved loop of intestine is shown in Figure 10. The radiated loop, when laid open, showed a definite stenosis, as illustrated in Figure 11. The opening was approximately 3/16 in. in diameter and the surrounding wall was much thickened and indurated. Small shallow areas of ulceration were observed scattered along the mucous membrane on either side of the stenosis for a short distance. It would appear that this animal overcame the primary ill effects secondary to the ulceration only to be overpowered by a partial intestinal obstruction. There are then, two possible causes for cachexia following overradiation of a single loop of intestine.

Although the end-results have been

FIG. 5. Dog No. 6 sixty-five days after the administration of a "dog erythema dose" to a loop of small intestine.

FIG. 6. Opened loop of small intestine removed from abdomen of dog No. 6, sixty-five days after radiation. There are areas of shallow ulceration in the mucous membrane.

demonstrated, the reasons for the cachexia are not easily found. The process may result from an interference with absorption or from a toxemia secondary to the absorption of toxic material from the intestinal lumen or from the ulcers themselves. The investigation of such a problem necessarily takes on considerable proportions, and we have not yet gone very far with it. The work of Mottram, Cramer and Drew[11] indicates that interference with absorption may play an important rôle.

FIG. 7. Dog No. 4 forty-one days after the administration of a "dog erythema dose" to a loop of small intestine. Emaciation is becoming pronounced.

FIG. 8. Dog No. 4 one hundred and seventeen days after radiation. The animal appears to be recovering and is gaining weight.

FIG. 9. Dog No. 4 one hundred and sixty-three days after radiation. The animal shows a rapidly progressive cachexia.

FIG. 10. A portion of small intestine removed from the abdomen of dog No. 4 one hundred and sixty-six days after radiation. The area between the arrows was indurated and contracted. The intestine above this point showed marked dilatation. The intestine below the radiated section appeared normal.

These observers were able to inhibit the absorption of fat from the intestine in rats by exposing the animals to large doses of radium. With smaller doses a partial inhibition was obtained. It was their belief that this change in absorption was secondary to a decreased leucocyte count, but we are of the opinion that the rays acted directly on the intestinal mucous membrane. In an effort to establish this point, isolated loops were exposed following operation in three dogs, according to the method described earlier in this paper. The doses administered were 15, 37.5 and 75 ma. min., the other factors being those used in the previous experiments. Fifteen ma. min. was used because it represents the minimum dose that produces a visible reaction on the human skin. After a week had elapsed with the

dogs in good condition each animal was fed ½ pt. of cream in the morning. Three hours later abdominal incisions were made following the administration of ether. The intestine of the dog receiving the smallest dose of *x*-rays appeared perfectly

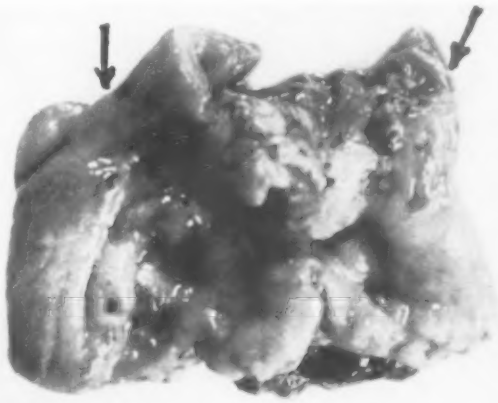

FIG. 11. The portion of bowel included between the arrows in Figure 10 has been laid open so as to show the area of stenosis which had produced a partial obstruction.

normal. The lymphatics of the mesenteries stood out in relief because of their engorgement with the absorbed fat. The other two animals showed a similar picture, except that no lymphatics could be made out in either case, in the mesenteries

FIG. 12. Opened loop of small intestine of a dog one week after receiving one-half of a "dog erythema dose." There are patches of ulceration found in the mucosa, but some of the mucous membrane appears to be intact.

leading away from the exposed loops. These findings indicate that large doses of rays applied directly to loops of intestine cause a definite inhibition of fat absorption in the exposed areas. It seemed possible that this might be due to a total destruction of the epithelium, but upon opening the exposed loop that received 37.5 ma. min. the greater portion of the mucous surface showed no gross abnormalities. A few small patches of ulceration were observed as shown in Figure 12. The remaining epithelial cells had apparently lost their power of absorbing fat. The gross appearance of the unopened loop is roughly shown in Figure 13. Frozen sections were prepared from this specimen and stained for fat with osmic acid. No evidence of intracellular fat could be made out. The most striking thing observed was the marked increase in goblet cells. In fact, almost every cell of the mucous membrane was markedly deformed by a huge collection of mucus. Mottram[11] has described these changes in mucus secretion following the exposure of rats to radium rays. It was his observation that the secretion of mucus may be markedly stimulated and later inhibited completely, as the dose is increased. It seems possible that the marked increase in mucus production may be responsible for the loss of absorptive

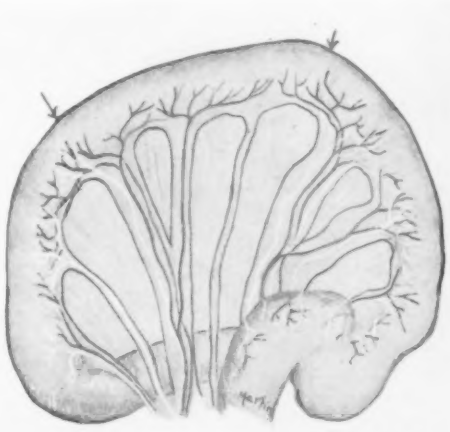

FIG. 13. Drawing representing the loop of intestine that received 37.5 ma. min. one week after exposure. The animal had a feeding of cream three hours prior to examination, but there is no fat in the lymphatics draining the exposed area.

power, although we have no direct proof to offer substantiating this suggestion.

It is also unreasonable to assume that the inhibition of the absorption of fat in a

single loop of small intestine can cause cachexia when the remaining intestine is functioning normally. However, the rapid death that occurs following the radiation of the whole abdomen may be caused by interference with absorption. Such a rapid syndrome could be easily explained if it were assumed that the absorption of water is inhibited, since an animal can live only a short time without water. The rabbits studied by Denis, Martin and Aldrich[10] showed a marked fall in urine output and a watery diarrhea, which facts point toward the elimination of unabsorbed water through the rectum. Obviously, our experimental data is insufficient to explain all of the observed phenomena. It is our desire to continue these studies with the hope of explaining some of the puzzling intestinal reactions.

We wish to acknowledge the valuable assistance of Dr. B. F. Hambleton and Dr. G. C. Caldwell in our operative and post-mortem work.

CONCLUSIONS

1. A large dose of *x*-rays delivered to the entire abdomen of an animal produces a rapid death a few days after the exposure. Smaller doses produce a rapid cachexia followed by death in two or three weeks; still smaller doses produce no noticeable effect

2. A large dose of *x*-rays delivered directly to a single isolated loop of the small intestine of a dog produces a slowly progressive cachexia. The animal may succumb in approximately two months during the stage of intestinal ulceration, or after five or six months from partial intestinal obstruction.

3. Fat absorption is inhibited when heavy doses of *x*-rays reach the small intestine.

4. The output of intestinal mucus may be markedly increased by heavy doses of *x*-rays delivered to the epithelium.

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It is curious that the Japanese should have anticipated Europe in a kind of rude regional anatomy. I have seen a manikin of Japanese make traced all over with lines, and points marking their intersection. By this their doctors are guided in the performance of acupuncture, marking the safe places to thrust in needles, as we buoy out our ship-channels, and doubtless indicating to learned eyes the spots where incautious meddling had led to those little accidents of shipwreck to which patients are unfortunately liable. From Border Lines of Knowledge in Some Provinces of Medical Science by Oliver Wendell Holmes.

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Ninth Annual Meeting: HOTEL DRAKE, CHICAGO, ILL., June 9–10, 1924.

THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY

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Information of interest to all readers will be found on page vii. Lists of officers of The American Roentgen Ray Society and The American Radium Society will be found on page preceding Editorial Section.

SIR ARCHIBALD DOUGLAS REID, K. B. E., C. M. G., D. M. R. E.

The news of the sudden, untimely death in Switzerland, of Sir Archibald Reid, Honorary Member of The American Roentgen Ray Society, came as a great shock to his friends in this country. His death at this time is well-nigh an irreparable loss to radiology not only in Great Britain, but all over the world. He had been the moving spirit in the organization of the British Institute of Radiology, for which he found suitable quarters and for the realization of which he worked day and night. It was his dream that this Institute should be the nucleus for a world-wide organization to further the science and profession of radiology; that it should be a central information bureau on everything connected with radiology, and that it should be a guide to the radiologists visiting London. In contrast to his English colleagues, who hesitated and wanted to go slowly and wait till there were sufficient funds to start operations, he argued that money would be forthcoming, if organization were begun and some progress shown. Acting on this theory he selected a suitable building for the Institute and began to carry out the necessary alterations. Although he is no more, this undertaking can not go back into oblivion. Had he been less active his death would probably have delayed the Institute for an indefinite period.

His was the spirit which accomplishes things and which we on this continent like to call American. Indeed, to the few of us who knew him personally, he seemed one of our own. He was so truly human that he could have seemed a compatriot to any national group.

Sir Archibald Reid was born on July 14, 1871. He graduated in medicine in 1901 and very soon interested himself in radiology. He first worked in the *X*-ray Department of the King's College Hospital. In 1911 he accepted the position of Superintendent of the Radiological Department at St. Thomas' Hospital, which position he held till his death. In addition he was radiologist and consulting radiologist to various other hospitals. He was Joint Secretary to the Radiological Section of the International Congress of Medicine held in London in 1913. He was President of the Electro-therapeutic Section of the Royal Society of Medicine for the year 1911–12, a member of the Council of the Roentgen Society, and Chairman of the Educational Committee of the British Association of Radiology and Electrology. When the latter organization established a diploma in radiology and electrology at Cambridge University, he set an example by submitting a thesis and taking that diploma in 1920. He cooperated in founding the Society of Radiographers three years ago and became its first president, which position he held for two years.

During the entire period of the World War, from 1914 to 1919, he was Chief of the *X*-ray Service in the British Army, his position being that of President of the War Service *X*-ray Committee.

A. J. R. & R. T., 3-1924

It was early during the latter year that I came in contact with him in an official capacity and it was then that I learned to respect and admire him. Although our contact was rather brief, I could not help coming under the spell of his charming personality.

Of his work as Chief of the *X*-ray Service in the army his co-workers could speak with greater authority, but I was impressed by what he had accomplished with the means at hand. It must be remembered that when England entered the World War the *x*-ray branch of the medical service was unprepared. I have even been informed on good authority that when the English roentgenologists at first offered their services they received a reply which amounted to a rebuke. Reid, however, was not discouraged by lack of official understanding of the *x*-ray needs of the army. The result was that the aforementioned committee was appointed and he was made president. The outfits available were mostly, or perhaps exclusively, coils and gas tubes. The English manufacturers had not yet gone into transformer building on the scale that the Americans had, and the Coolidge tube was as yet in its infancy. It was not even manufactured in England at the time. The radiator type tube had not yet been thought of; it was developed by Coolidge in response to our war demands early in 1917. In view of the submarine warfare and consequent uncertainty of obtaining a regular supply of *x*-ray materials from abroad, Reid was compelled to limit himself to what the English manufacturers were equipped for and had been in the habit of making, without embarking upon new experiments. When one remembers that we, 2½ or 3 years later, had to begin our work in France with equipment which we bought there, it will be easy to appreciate the difficulties encountered by him. When one realizes that he not only had to provide equipment for the western front, but also for the Galipoli and Suez Canal battlefields and later for Palestine, Syria and Mesopotamia, one can get a conception of the magnitude of his task and the difficulties which he encountered. But these could neither dampen his ardor nor crush his spirit. He was always on the alert, always cheerful, and always an inspiration to his assistants and co-workers.

His services were fittingly recognized by the British Government in conferring knighthood upon him.

During the war he edited an English translation of Ledoux-Lebard and Ombredanne's book on the localization and extraction of projectiles. Previously he wrote an article on the *x*-ray diagnosis of calculi for the 1905 edition of Rose and Carless's Surgery, and one on the treatment of rodent ulcer for Cheyne and Burghard's Manual of Surgical Treatment. He was also the author of many other contributions to *x*-ray diagnosis.

When the war was over, he, in conjunction with others, became interested in the formation of an International Radiological Organization. It was not due to any shortcoming of his that the plans have not yet been realized. The conditions of Europe and the temper of its people are such as to make difficult, if not impossible, cooperation among the older and the newly created national units. He nevertheless felt that such an organization should be created and the sooner the better. If I understood him aright, he thought that the British Institute of Radiology, which was the last great thing to which he was giving his time and his labor, would be the beginning of such an organization. He believed that it could be started by interesting those of the Allies and those of the Neutrals who would care to come in now, and that later the others would follow suit. His compatriots could provide no finer memorial to him than to make all possible effort to realize his dream; and we, in America, could show no better evidence of our love and respect for our English brethren than by helping along individually and collectively in this great undertaking.

L. JACHES.

THE DIAGNOSIS OF HEALED MILIARY TUBERCULOSIS

Acute miliary tuberculosis, contrary to widely prevalent opinion, does not always pursue a rapidly fatal course. The older literature is reviewed by Cornet in Nothnagel's "Practice of Medicine" and in-

stances are cited in which, perhaps with initial symptoms suggestive of miliary tuberculosis, the course of the disease has been prolonged and obsolescent tubercles have been found in the lungs or other organs. The author states that in rare and very exceptional cases acute miliary tuberculosis ends in complete recovery. Wunderlich[1] described a case in which death occurred from causes other than tuberculosis four months after onset of symptoms and autopsy showed the presence of old miliary tuberculosis. Burkart[2] described instances of miliary tuberculosis in which the character of the tubercles furnished evidence that they had existed a considerable period before death; and in two instances the lungs as well as other organs contained numerous encapsulated nodules which had undergone calcification. Longcope[3] has described six instances of chronic miliary tuberculosis.

Healed and calcified miliary tubercles are not infrequently found in the liver and spleen of individuals with conspicuous healed lesions of tuberculosis in the lungs and bronchial lymph-nodes. During the period of activity a few tubercle bacilli have escaped from the primary foci and given rise to scattered tubercles in distant organs, but the widespread dissemination of acute miliary tubercles is not reproduced. Nevertheless these nodules, which consist of a calcified center surrounded by a fibrous capsule, show that healing miliary tubercles may undergo calcification. They are readily identified in roentgenograms of the organs made after death.

When small nodules of uniform size with opacity suggesting calcification are uniformly scattered throughout a chest plate, healed miliary tuberculosis suggests itself and this diagnosis has been made in several instances. Conclusive evidence in favor of this view has been lacking and there has been much difference of opinion concerning the interpretation of these plates.

Widespread dissemination of calcified nodules within the lung substance may be the result of disseminated tuberculous bronchopneumonia which, occurring in childhood, has undergone complete healing. A roentgenogram of a lung in a published instance shows[1] almost uniform distribution of small spherical calcified nodules; but extensive calcified lesions in the bronchial lymph-nodes and absence of healed tubercles in abdominal organs indicate that the individual has survived disseminated pulmonary rather than acute miliary tuberculosis. Nevertheless there is no good reason to doubt that lesions of this type are tuberculous in origin, for other varieties of calcification which are found at autopsy within the lung would not produce the same appearance in a roentgen-ray plate.

Phleboliths, bronchioliths or calcified plates within the pleura do not occur in forms which might suggest miliary tubercles in an *x*-ray plate. There is no pulmonary parasite which with calcification might produce nodular spots. Metastatic calcification has been vaguely suggested. Virchow first described this condition in association with destructive lesions of bone which presumably liberate calcium salts and bring about an over-saturation of the blood. Calcium deposit tends to occur in those tissues where carbon dioxide content is least, namely, in the endocardium of the left side of the heart and in the intima of the pulmonary veins (Wells).[2] Diffuse calcification which affects the alveolar walls of the lung occurs in the form of minute platelets, rods, and scales. There is no probability that a roentgen-ray plate made during life would suggest miliary tuberculosis in these cases.

Though recovery from acute miliary tuberculosis is possible and might result in the formation of calcified nodules within the lungs, proof of these events is difficult to obtain during life. A considerable interval following symptoms suggesting acute miliary tuberculosis would support a diagnosis of healed miliary tuberculosis but in most instances in which disseminated miliary tuberculosis has pursued a chronic course the symptoms have not been characteristic. Roentgenograms made repeatedly during the course of miliary tuberculosis might furnish evidence of recovery with calcification of the nodules. Complete disappearance of tubercles has

[1] *Arch. der Heilkunde*, 1860, i, 289.
[2] *Deutsch. Arch. f. klin.* Med., 1873, xii, 277.
[3] *Bull. Ayer Clin. Lab.*, 1906, vol. i.

[1] *Am. Rev. Tuberc.*, 1920, iv, 629.
[2] *Arch. Int. Med.*, 1915, xv, 574.

been described in one instance, tubercles being recognized in the first plate and absent in one made subsequently, but although it is not inconceivable that disseminated tubercles might undergo resolution, there is no evidence which will establish this opinion.

In rare instances recovery from acute miliary tuberculosis occurs and tubercles with or without calcification doubtless cast shadows visible in a chest plate. With the difficulties in mind a diagnosis of healed miliary tuberculosis is possible.

EUGENE L. OPIE, M.D.

CARE IN PREPARATION OF MEDICAL PAPERS

During the past few months the editor of this JOURNAL has been at some pains to verify the references in bibliographies presented with papers for publication. We have been astonished to find mistakes in 10 to 20 per cent of the references, and in some lists a very much higher percentage of error.

Examination of reference lists published in recent numbers of prominent medical journals shows that carelessness in preparation of medical bibliographies is by no means confined to contributors to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY. For instance, in a recent number of a well-known journal a bibliography of eleven references is appended to one of the articles. Only three of these references are in all respects correct. In five, the title is wrongly quoted; in two, the year of publication is incorrectly stated; and in three, the pages referred to are wrong.

It has been our experience more than once to fail to find an article because of incorrect data in some writer's reference list. Sometimes the author's name or initials are incorrect; the year, volume or page is wrong, and even the name of the journal may not be correctly given.

The following is a quotation from an editorial on this subject in the *Boston Medical and Surgical Journal*, June 28, 1923:

"A very few of the American medical publications verify such references and these are to be thanked for the hours of labor and careful search they have spared other investigators. In a recent extensive bulletin no less than eight references out of twenty-eight were wrong, two authors' names were spelled incorrectly and two articles were quoted that had no reference whatsoever to the text of the author's paper."

It is an imposition upon readers to present to them a list of references to the literature of a subject, only to have them discover after an annoying search that many of the references are incorrect, that some of the articles cannot be found, and that others have no bearing upon the subject.

Every author should either himself verify all his references or have them verified by a competent person. In the larger cities someone can usually be found in the medical library who will perform this work. If a writer has no one at hand upon whom he can rely, we shall be pleased, upon request, to furnish the name of someone who is willing and competent to do such work.

It is with great regret that we announce the death at Rochester, Minn., of Dr. R. Walter Mills of St. Louis, Mo., on February 16, 1924.

An account of his life will be published in the next issue of the Journal.

Subscribers to THE AMERICAN JOURNAL OF ROENTGENOLOGY AND RADIUM THERAPY *visiting New York City, are invited to make the office of* THE JOURNAL *(69 East 59th Street, New York) their headquarters. Mail, packages or bundles may be addressed in our care. Hotel reservations will gladly be made for those advising us in advance; kindly notify us in detail as to requirements and prices. List of operations in New York hospitals on file in our office daily.*

SOCIETY PROCEEDINGS, CORRESPONDENCE AND NEWS ITEMS

Items for this column solicited promptly after the events to which they refer.

NEW ROENTGEN SOCIETIES ORGANIZED

THE CLEVELAND RADIOLOGICAL SOCIETY has been organized with the following officers: President, Dr. G. F. Thomas; Vice-President, Dr. E. F. Freedman; Secretary-Treasurer, Dr. J. D. Osmond.

The meetings are held at dinner, on the second Monday evening of each month.

THE MILWAUKEE COUNTY ROENTGEN SOCIETY was organized on February 1, 1924. Its object is not only to emphasize roentgenology as a specialty, but to promote it by educational propaganda and closer relationship with the entire medical profession.

The following officers were elected: President, Dr. F. W. Mackoy; Vice-President, Dr. H. B. Podlaski; Secretary-Treasurer, Dr. C. W. Geyer.

The society meets on the first Friday of each month.

ROENTGENOLOGY IN OBSTETRICS

The Society of Obstetrics and Gynecology of Paris, on November 12, 1923, upon motion of M. Le Lorier, unanimously passed the following resolution:

"The Society of Obstetrics and Gynecology of Paris regret the absence of a laboratory for obstetrical radiology in a teaching and research center such as Paris.

"Considering the service which obstetrical radiology can now render and the still more valuable service which it will render in the future,

"Resolved: That there be created in one of the hospitals of Paris, provided with a maternity service, a central laboratory of radiology, specializing in obstetrical examinations, provided with the necessary space, material and personnel;

"And further resolved, that this resolution be transmitted to the obstetrical societies of the hospitals with a view to community effort in carrying out this resolution."

Dr. James T. Case, commenting upon the above resolution, writes: "It would not be a bad idea if in some of the large cities of this country, similar action might be initiated."

RADIUM SOCIETY MEETING

The American Radium Society will hold its Ninth Annual meeting at the Drake Hotel, Chicago, June 9 and 10, 1924. Those who expect to attend the American Medical Association meetings at the same time, will find this one of the most up-to-date and conveniently located hotels in Chicago, especially in relation to exhibits and scientific sessions. Reservations can be made immediately through the Arrangement Committee of the American Radium Society by addressing Dr. Henry Schmitz, 25 East Washington St., Chicago.

The scientific sessions of the American Radium Society will be held at the Drake Hotel. Further information will be announced when the arrangements have been fully completed.

Contributions for the program should be forwarded at once to G. E. Pfahler, M.D., Chairman of the Program Committee, 1321 Spruce St., Philadelphia, Pa.

REQUEST FOR BIBLIOGRAPHIES

Dr. J. Wetterer of Mannheim, Germany, has been commissioned by *Strahlentherapie* to edit a special volume entitled "Radiotherapy in Foreign Countries." Dr. Wetterer proposes not only to enumerate the contents of all articles and books which appeared between 1922 and 1924 on roentgenology and radium therapy, in countries other than Germany, but to describe the progress of technique and apparatus.

In order to accomplish this purpose he requests that each author send to him as soon as possible a complete bibliography of his own articles published since 1922, together with a concise abstract of each article. The work is to be published not only in the projected volume of *Strahlentherapie* but also in a new edition of Dr. Wetterer's "Handbuch der Röntgen und Radiumtherapie."

The work must be completed at an early date, and haste is urged in sending the data. Address Dr. J. Wetterer, Mannheim 02, 1 (Germany).

DEPARTMENT OF TECHNIQUE

Department Editor: DAVID R. BOWEN, M.D., Pennsylvania Hospital, Philadelphia, Pa.

In this department will be published from time to time, as material is available, suggestions for improvement in technique.

THE CONTOUR OF THE ISOLATED ENTIRE DUODENUM

BY J. BUCKSTEIN, M.D.

NEW YORK CITY

THE method employed as routine for the roentgenographic visualization of the duodenum depends upon the expulsive mechanism of the stomach. The stomach must first be filled with a radiopaque mixture. Only small amounts are ejected into the small intestine, because of the controlling function of the pyloric sphincter. As each small amount of the mixture enters the duodenum, it is rapidly hurried on its way by means of the normal intestinal peristalsis. As the result, the filling of the entire duodenal curve, with the exception of the cap, occurs in fragmentary fashion. Only a general impression of the sweep of the duodenal curve is ordinarily obtainable. An intimate knowledge of the radiographic structure of the duodenum, beyond the first portion, is very frequently impossible. Moreover, the barium-filled stomach may over-lie a portion of the transverse duodenum and prevent a proper visualization of this region.

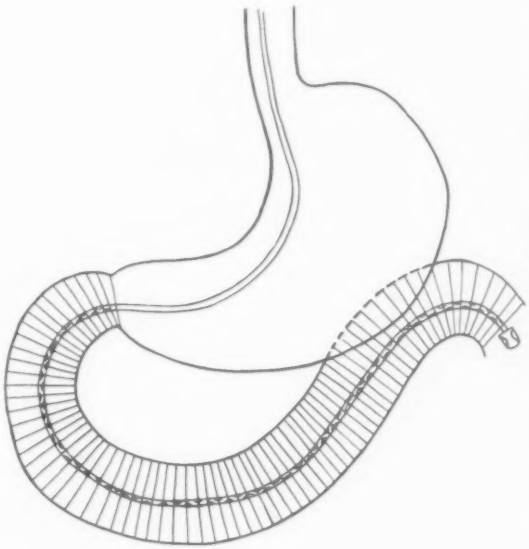

FIG. 1.

The isolated entire duodenum may be filled in homogeneous fashion by means of the following simple procedure: An intestinal tube 45 in. long is constructed, so that the distal 12 in. of rubber has numerous small perforations. The tube is swallowed by the patient until the metal end reaches the duodenojejunal junction. This is determined roentgenoscopically. About 40 c.c. of a barium suspension is injected through the proximal end. The mixture, on escaping through the perforations of the distal end of the tube, will completely fill the intestinal area subjected to this flow. All this region will be filled at practically one and the same time. A

FIG. 2.

roentgenogram is taken immediately upon completing the injection.

The method is of value for the following purposes:

1. A study of the variations in the size of the duodenal curve as compared with variations in body habitus.

2. To determine enlargement of the duodenal curve, where a tumor of the head of the pancreas is suspected.

3. To demonstrate the intimate connection with the lumen of the intestine of a suspected diverticulum.

4. For the more accurate visualization of distortions in contour, due to extra-duodenal pathology.

5. For the detection of intrinsic changes due to ulceration or infiltration, in regions beyond the first portion of the duodenum.

A DIAGNOSTIC NEEDLE AND SPECIMEN OBTAINER

BY JOSEPH MUIR, M.D.

NEW YORK CITY

THIS instrument is designed to secure tissue specimens for pathological examination from regions not accessible by the ordinary open methods of approach. By its use a sufficiently inclusive tissue plug can be removed from any depth within its length with a minimum of traumatism, and the extent of a growth, indicated by roentgen-ray or other findings can be checked up by spacing a number of stabs of varying depths over the suspected area. An important feature of the instrument is that its construction precludes the possibility of malignant tissue-fragments being carried into healthy tissue.

DESCRIPTION OF INSTRUMENT

The instrument consists, first, of the sheath A, having a knurled collar (1) by which the instrument is grasped when in use at its outer end, and a window (2) ¾ in. long, at its inner end. Into this sheath fits the stabbing needle B, with the handle (1) at its outer end and a deep groove (2) at its inner end. This groove is the essential portion of the instrument and corresponds exactly with the window in the sheath when the needle is fully within the sheath. The cross section of the groove is such that whenever the needle is rotated within the sheath in clockwise direction,

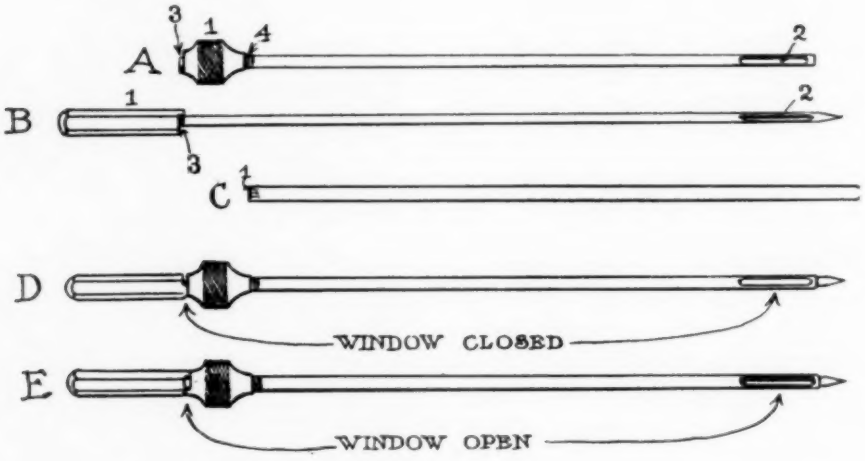

FIGURE ONE (1)

its upper edge acts as a knife, cutting into whatever tissue may have been forced through the window into the groove, and on further rotation, this cutting edge passes beneath the lower edge of the window, the ungrooved portion of that part

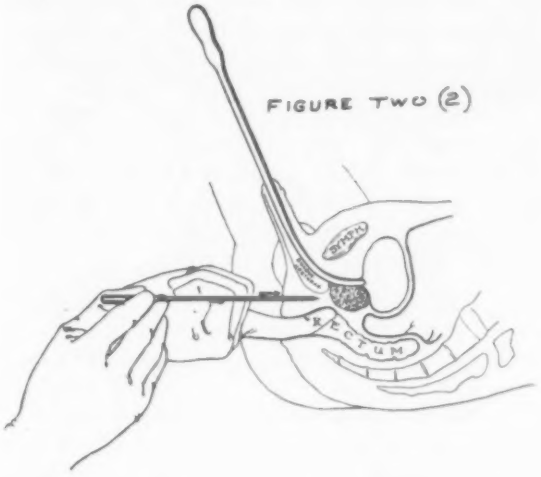

FIGURE TWO (2)

of the needle obturating the window. Thus, the tissue plug obtained remains within the groove and completely obtected by the wall of the sheath.

Notches (3) cut into adjoining ends of A-1 and B-1 indicate the relative position

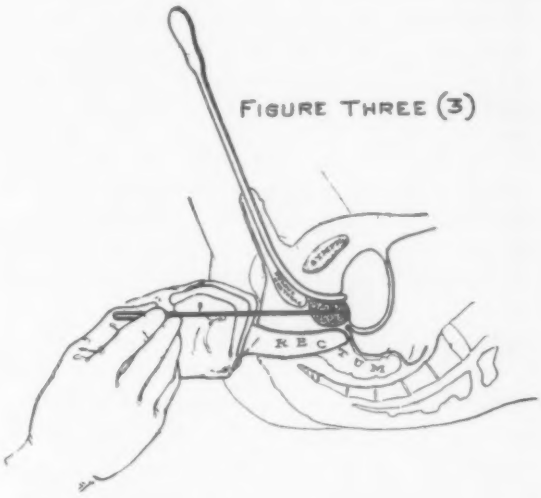

FIGURE THREE (3)

of groove and of window and, contingently, the amount of twist required to complete the cutting turn of the needle.

A third part of the instrument is the case C, with an inner screw-thread (1) which corresponds to the screw-thread A 4, on the head of the sheath. This case not only protects the point of the needle but also permits the instrument to be carried about in a sterile condition, and in the event of only one specimen having been secured, the latter may be carried to the laboratory without removal from the groove.

The following description concerns the use of the instrument in suspected malignancy of the prostate.

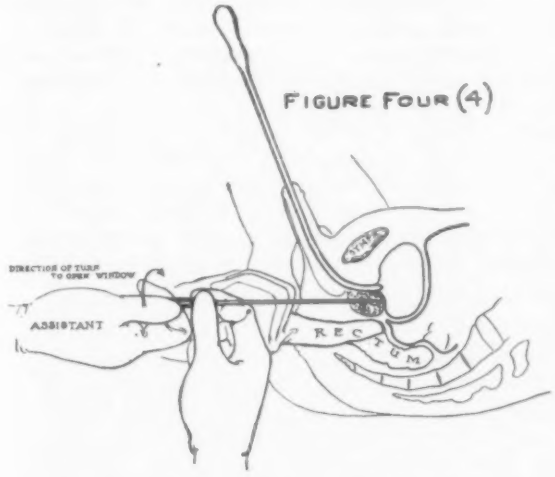

FIGURE FOUR (4)

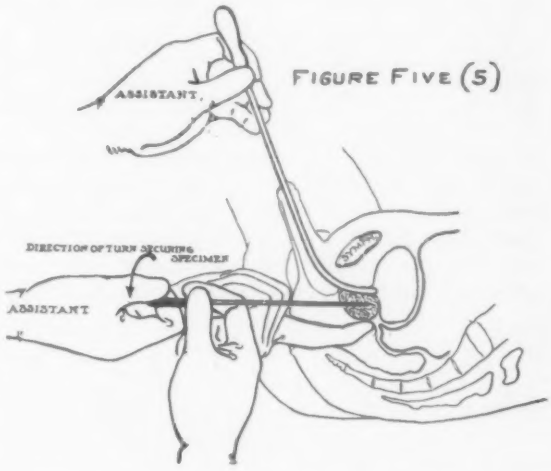

FIGURE FIVE (5)

The patient is placed in the lithotomy position and the perineum rendered surgically clean. With a metal catheter in the urethra, the operator explores the affected prostate with the finger in recto. The

proper spot of entry, between anus and bulbus urethrae, having been chosen, the sterilized instrument with the window closed, as shown in D, is pushed inward, the finger tip in recto guiding the progress of the needle-point (Fig. 2). The inward progress of the needle is continued until the proper spot has been reached (Fig. 3). As soon as this point has been reached, the operator makes sure that the window faces the tip of the finger. This can be easily determined by the position of the notches A 3 and B 3. At this juncture the operator takes a firm hold of the head of the sheath to prevent it from turning and an assistant grasps the head of the needle (Fig. 4), the operator's finger in recto not making any undue pressure against the instrument.

In the next step the assistant turns the needle in the sheath as far as the notch will permit, thus opening the window to the groove as shown in E, and the operator gently pushes the tip of his finger in recto against the instrument, the assistant, meanwhile making counterpressure by taking hold of the metal catheter (Fig. 5). This procedure assists in forcing tissue into the groove.

Finally, with hands and instruments in this position, the assistant twists the needle back to the position D. The tissue plug is now contained within the groove and protected by the sheath, and the whole instrument is withdrawn.

Undoubtedly, many a man has, in the contemplation of x-ray apparatus for his office, given serious thought to the type of equipment which he wished to install, and has assumed that with a modern laboratory, he would be in a position to render the best of service. Such a misguided individual learns all too soon that a very large part of the battle lies within himself, and if his own knowledge is deficient, the finest equipment in the world will not make him a roentgenologist. It is important, therefore, that those who contemplate any indulgence in this field should not underestimate the task that confronts them or consider lightly the responsibilities it entails.

In addition to becoming familiar with the electro-physics of x-ray laboratory equipment, its practical application in his chosen field and the dangers which surround it if improperly used, one should realize that the real practice of roentgenology begins when the x-ray picture or radiogram, has been produced. It is quite impossible for such an image to be of value unless the roentgenologist is thoroughly familiar with the anatomy, physiology and pathology of the field under examination; and even these qualifications are not adequate unless backed up by practical clinical experience. From DENTAL AND ORAL RADIOGRAPHY by JAMES DAVID MCCOY, M.S., D.D.S., F.A.C.D.

BOOK REVIEWS

Books Received Are Acknowledged under Heading: Books Received. This must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

RADIOGRAPHY AND RADIO-THERAPEUTICS. By Robert Knox, M.D. C.M. (Edin.), M.R.C.S. (Eng.), L.R.C.P. (Lond.), Consulting Radiologist, Great Northern Central Hospital, London; Hon. Radiographer, King's College Hospital, London; Director, Electrical and Radio-Therapeutic Department, Cancer Hospital, London; Captain R.A.M.C. (T.) 4th London General Hospital (In Charge of *X*-ray Department). Cloth. Price $12.50. 429 pages, with 93 plates (1 in color) and 337 illustrations. Part I, Radiography, 4th Ed. Macmillan, New York, 1924.

The Fourth Edition of Radiography more than ever establishes it as the standard English text and reference book on this subject. Some additions have been made since the third edition which bring the work well abreast of the advances in both technique and diagnosis. The additions are found particularly in the chapters on the Liver, Gall-Bladder and Urinary tract, but minor additions will be found throughout the volume. Among the latter are descriptions of the Coolidge Portable *X*-ray Outfit, The New Portable *X*-ray Outfit for Military use, such as was used in the U. S. Army during the World War, a complete description of the Potter-Bucky diaphragm, and a brief description of the Lilienfeld tube.

PRURITUS OF THE PERINEUM (PRURITUS ANI, VULVAE AND SCROTI). By Joseph Franklin Montague, M.D. of the Rectal Clinic, University and Bellevue Hospital Medical College; Fellow American Proctologic Society and New York Pathological Society. Foreword by George David Stewart, M.D., President of the New York Academy of Medicine. Cloth. Price $3.50. 199 pages, with 37 illustrations. Paul B. Hoeber, Inc., New York, 1924.

Dr. Stewart says in the foreword: "Dr. Montague's monograph is a methodical, careful survey of the subject from all points of view, physiological, anatomical, pathological, etc." The book does, in fact, cover every phase of the subject, and is based not on a study of the literature alone but on careful experimental and clinical observation.

Under Treatment the author describes palliative and curative measures and under the latter he gives consideration to roentgenotherapy, radium therapy, ionic medication and surgery. Several operations for pruritus ani are described, including the author's own method.

There is appended a very complete bibliography.

PIERRE CURIE. By Marie Curie. Price $2.25. Contains 242 pages. The Macmillan Co., New York, 1923.

This is one of the most attractive biographies that it has been our lot to read for many a day. A woman, a great scientist herself, tells in simple language the life story of her husband, Pierre Curie.

The vivid interest of the story lies not so much in a recital of the important achievements of a great scientist as in an intimate portrayal of the high ideals of a lofty character. How Pierre Curie literally dedicated his life to science; how, in spite of poverty and hardship, he adhered to his altruistic ideals; how he refused a professorship at Geneva which would have insured an easier life, but which he believed would interfere with his scientific work; how he also refused to allow his name to be presented for the *Palmes academiques* and later refused the decoration of the Legion d'Honneur; how he had the confidence of Berthelot, Lord Kelvin, and other great men of his time; how he was finally enabled to pursue his scientific work without worry by appointment as professor in the Sorbonne and by the granting of the Nobel prize; and how he had scarcely adjusted himself to this new outlook when he was suddenly killed at the

age of only forty-six years—all of this, and in addition the story of a beautiful home life, is told interestingly and unaffectedly by the comrade who shared both his home and his work.

Pierre Curie's attitude toward decorations arose from his sincere belief that they were distinctly harmful and "that they can degrade the worthiest aim of man, which is, work for the pure love of it."

Not the least attractive part of the book is Marie Curie's own autobiography. Her story of the discovery of radium is full of interest and must offer great inspiration to those who are carrying on scientific investigation under adverse circumstances. The following quotations are taken from this fascinating account of a great discovery:

"I had decided on a theme for my doctorate. My attention had been drawn to the interesting experiments of Henri Becquerel on the salts of the rare metal uranium. Becquerel had shown that by placing some uranium salt on a photographic plate, covered with black paper, the plate would be affected as if light had fallen on it. The effect is produced by special rays which are emitted by the uranium salt and are different from ordinary luminous rays as they can pass through black paper. Becquerel also showed that these rays can discharge an electroscope. He at first thought that the uranium rays were produced as a result of exposing the uranium salt to light, but experiment showed that salts kept for several months in the dark continued the peculiar rays. . . . I then thought to find out if there were other substances possessing this remarkable property of uranium, and soon found that substances containing thorium behaved in a similar way, and that this behavior depended similarly on an atomic property of thorium. I was now about to undertake a detailed study of the uranium and thorium rays when I discovered a new interesting fact. I had occasion to examine a certain number of minerals. A few of them showed activity; they were those containing either uranium or thorium. The activity of these minerals would have had nothing astonishing about it, if it had been in proportion to the quantities of uranium or thorium contained in them. But it was not so. Some of these minerals revealed an activity three or four times greater than that of uranium. I verified this surprising fact carefully, and could not doubt its truth. Speculating about the reason for this, there seemed to be but one explanation. There must be, I thought, some unknown substance, very active, in these minerals. My husband agreed with me and I urged that we search at once for this hypothetical substance, thinking that, with joined efforts, a result would be quickly obtained. Neither of us could foresee that in beginning this work we were to enter the path of a new science which we should follow for all our future."

The story continues with an account of the discovery of polonium and finally of radium, and then goes on to tell of four years of arduous labor in an old shed until she and her husband were finally able to isolate radium and to determine its atomic weight.

American readers of this book will feel a real sense of gratitude to Mrs. William Brown Meloney who prevailed upon Mme. Curie to write it.

BOOKS RECEIVED

A System of Surgery. 2nd Ed. By C. C. Choyce, C.M.G., C.B.E., B.Sc., M.D., F.R.C.S., and J. Martin Beattie, M.A., M.D., C.M. Price $35.00. 3 Vols. 3300 pages, with 50 color plates, 98 half-tone plates and 910 figures. New York: Paul B. Hoeber, Inc., 1923.

Lectures on Endocrinology. By Walter Timme, M.D. Price $1.50. 133 pages, with 27 illustrations. New York: Paul B. Hoeber, Inc., 1924.

Pruritus of the Perineum. By Joseph F. Montague, M.D. Cloth. Price $3.50. 199 pages, with 37 illustrations. Paul B. Hoeber, Inc., New York, 1923.

X-Rays: Their Origin, Dosage and Practical Application. By W. E. Schall, B. C. Lond., F. Inst. P. 119 pages. Bristol: John Wright & Sons, Ltd., 1923.

INTERNATIONAL ABSTRACTS OF ROENTGEN AND RADIUM LITERATURE

GANN, DEWELL. The review of forty consecutive cases of carcinoma of the cervix. *Urol. & Cutan. Rev.*, Sept., 1923, xxvii, 563.

These cases were divided into: Operable, in which the disease was limited to the cervix; inoperable, which involved the parametria; and border-line, in which there was bladder and rectal involvement.

The youngest case was thirty, the oldest sixty-eight; the approximate average being fifty-one; 24 were between fifty and sixty years old, all were married or widowed; 38 had given birth to children—from one to eleven, an average of four; 15 were treated surgically, 17 by radium, 1 by radium and surgery, 3 by radium and roentgen ray, 1 by Percy cautery, 2 by cautery, 2 by cautery preceding the application of radium.

The roentgen treatment here referred to was the ordinary deep therapy with Coolidge tube and not the high voltage machine now in use.

All the cases were treated between July 8, 1920, and July 31, 1922.

Of the 15 surgical cases 7 are living and apparently well, 2 are dead, and 6 not heard from. Of the 7 living, 2 had Wertheims and 1 a high amputation of the cervix.

Of the 4 traced living cases of radium, all are apparently well. Of the 2 known dead, 1 had a Wertheim and the other died as a result of a malarial hematuria four months after a panhysterectomy.

Of the 18 inoperable cases, 10 were treated with radium, 2 with radium and roentgen ray, with cautery preceding radium, 2 with cautery alone, 1 with Percy cautery, and 1 refused treatment.

Twelve are apparently well. Six have not been heard from.

Of the 5 borderline cases, 1 had a Wertheim, 1 a panhysterectomy, 2 radium, 1 radium and roentgen ray. The Wertheim is living two and one-half years after operation. The panhysterectomy has not been heard from. Of the 2 radium cases, 1 is alive, and 1 dead from diabetes mellitus. The case treated by roentgen ray and radium is alive two years after treatment.

GOIN, LOWELL S. The Holfelder technique in deep therapy. *J. Radiol.*, Oct., 1923, iv, 354.

The basis of deep therapy is founded upon the biological experience that different cell-forms exhibit different sensibilities to the roentgen-ray. Different cell-sensibilities are manifested to different degrees of hardness of roentgen ray. These differences in sensibility depend upon the production of a homogeneous field.

Heterogeneity if greater than the sensibility between the normal and pathological cells, will prevent success. The law of effective action may be stated: $I \times T \times Sp > I \times T \times Sn$, in which I is the intensity of radiation, T is the time of application, Sp is the degree of sensibility of the pathological cells, and Sn is that of the normal cells.

Homogeneity must be both qualitative and quantitative. For practical purposes rays are homogeneous, if their intensities do not vary more than 5 per cent.

Holfelder has devised an instrument by which actual homogeneity may be attained and smaller fields may be used, and the cones of rays more accurately directed so as to avoid important organs which should not be radiated. It has been found that only with 3, 5 or other odd numbers of courses can a homogeneous radiation be made. The percentage dose is the amount of radiation 10 cm. in the depth in relation to the surface dose, and may be expressed in terms of percentage by the formula:

$$\frac{i^1 \times 100}{i^2} = \text{P.D.D.}$$

i^1 being the discharge time of the iontoquantimeter with given factors, i^2 the discharge time with the same factors in a 10 cm. depth. Holfelder believes that the varying degrees of hardness produced by increasing the thickness of an already heavy filter are not important biologically, and in using the field selector the various percentage depth doses are produced by varying the size of the field and the target-skin distance, the voltage and filtration remaining constant.

The field selector is made from truncated triangles of photographically tinted celluloid and an illuminated glass plate on which is painted a series of geometrical figures of varying density and of the same color as the trial fields. The tint of the trial fields goes from dark to light from above downward, in carefully calculated percentages, on the glass plate. There are a great number of figures, squares, triangles, points and circles. Each square, each triangle, each point and each circle is of exactly the same tint, but the circles are much darker than the points, the points are darker than the squares and the triangles are the lightest of all.

To apply this, a strip of block tin is molded to the cross-section of the body at the proper level and then by the proper means the tumor is located within the block tin outline of the cross section. Then the trial fields are selected by trial and error, crossing the parts to be irradiated, and avoiding those not to be rayed.

Homogeneity in the radiated area is a prime essential.

Better homogeneity is obtained by using three or five fields than by the use of two or four.

The use of small fields is necessary for the treatment of disease in certain regions.

The Holfelder field selector offers a means of attaining better homogeneity, permits of accurate cross-firing and enables the ray-cones to be directed in such a manner as to avoid the radiation of important uninvolved organs. It therefore offers the most accurate and scientific means of applying roentgen ray for deep therapy.

GROSS, O. Roentgen diagnosis of pancreatic diseases. *Klin. Wchnschr.*, 1923, ii, 1346.

According to Pueschel, pancreatic processes which cause a diminution of space will be characterized by:

1. Formation of a small high gastric shadow.
2. Bulging of lesser curvature.
3. Formation of defect, simulating gastric carcinoma.
4. Engorgement and displacement of the duodenum.
5. Compression of transverse colon.

The larger the pancreatic tumor the more marked will be these symptoms. It is especially marked in cysts and pseudo-cysts.

The first pancreatic cyst reported was that found by Schlesinger. The author, in his own case, did not find the gastric shadow diminished and displaced upward, and toward the left, but downward, with the duodenum. It twined around the cyst with the duodenum, like a thin rubber tube. The aboral part of the stomach was well demonstrable. An ectasis had not yet formed because the case had developed only a few months prior as the result of trauma which had occasioned a pseudo-cyst.

HARRIS, D. J. Some observations on the behaviour of lymphosarcomata under radium treatment. *Practitioner*, Oct., 1923, cxi, 291.

Three cases of lymphosarcomata occurring within the last twelve months, are reported, in which radium was used with apparent recovery. A recurrence, with resistance of the new growth to the action of radium, with speedy death, followed.

In the first case, the introduction of radium on one side produced unmistakable softening and diminution, not only on that side but on the other side also. In each case the growths, after disappearing almost completely, recurred and grew more rapidly than before.

Upon what lines is the explanation to be sought? The theory must explain the disappearance of sarcomatous lesions at a distance from the site of radiation. It must explain the rapid recrudescence, and the ineffectiveness of repeating the radium.

Loeper and Tonnet reported that as a result of radiation of cancerous tumors they found:

1. An increase in the total protein in the serum mainly affecting the globulin.
2. An increase in the aminoacids in the serum.
3. An increase in the lipoids and protein sugar in the serum.

These blood changes are not due to destruction of leucocytes, but to destruction of the cancer cells.

To correlate the clinical observations we conceive that the first effect of radiation is to kill a few cells in the immediate vicinity of the tubes; that these cells are attacked by the tissue proteolytic ferments; that the products of the action of these ferments act as antigens which stimulate into activity the defensive resources of the body to produce coagulins and lysins; that the effect of these substances is not confined to the site of radiation, causing the disappearance of the growth there, but extends to more remote deposits and influences these also.

The practical question, however, concerns the fate of these antibodies. How long do they exist in the blood? The fact that the growth persists suggests that they have only a transient existence. The fact (if established as such) that the recurrence is more rapid than the original process, and that the re-insertion of radium, after an interval of a month or more seems comparatively ineffective, suggests that not only have the coagulins and lysins disappeared from the blood by that time, but that prior to their disappearance they have caused the production of anti-coagulins and anti-lysins. If that is indeed so, the moral is that the repetition of radiation must be carried out at short intervals of less than a month, in order to anticipate the completion of the cycle just referred to.

GYOERGY, P., and GOTTLIEB, K. Intensification of radiation therapy in rachitis by per os administration of eosin. *Klin. Wchnschr.*, 1923, ii, 1302.

In treating rachitis with ultraviolet rays the results were improved by giving the children 9.1 gm. of eosin crystal (the bluish

Hoechst preparation) with 0.2 gm. cane sugar by mouth. The results were verified by series of roentgenograms and blood tests.

HAWES, JOHN B. Progress in pulmonary diseases. *Boston M. & S. J.*, Nov. 1, 1923, clxxxix, 635.

P. H. Ringer is quoted as saying that the presence of tuberculosis is based upon five points, the second is roentgenologic, which as the sole evidence of active tuberculosis should not be relied on.

F. S. Bissell says that the matter should be determined by the clinical evidence, and that the conservative roentgenologist will not venture a prognosis in a given case. The negative roentgenologic report has not been given the high place it deserves. The diagnosis of pulmonary tuberculosis should not be made in the face of repeated negative roentgen-ray findings.

HODGES, FRED M. Pericarditis with effusion. *J. Radiol.*, Oct., 1923, iv, 351.

Williamson states that, in pericarditis, with effusion the fluid accumulates first in the costodiaphragmatic angle. This pushes down the left lobe of the liver.

The pericardial rub may persist in fairly large effusion.

The roentgen ray has its greatest usefulness when the effusion exceeds from 150 to 200 c.c. in showing approximately the amount of fluid present and the best location for paracentesis. At times, owing to consolidation in the lung and no to-and-fro friction sound, a diagnosis without the roentgen ray is practically impossible.

Holmes has shown that when the heart is suspended in solutions with a specific gravity between 1.012 and 1.020, its outline cannot be made out by the roentgen ray. He found an absence of pulsation on roentgenoscopic examination about as frequently in markedly dilated hearts as when there was a large effusion. He was unable to see the outline of the heart within the pericardium in any case.

In 16 cases studied there were 200 or more c.c. present, and in 10 of these the roentgen ray showed definite indications of fluid within the pericardium.

In these findings were: (1) A general increase in the width of the cardiac outline; (2) a widening of the mediastinal shadow, which changed with change in position of the patient; (3) a straightening out of the curves of the left border of the heart; (4) the absence of, or weak cardiac pulsations noted, on the roentgenoscopic screen; (5) a change in the space formed by the diaphragm, spine and posterior border of the heart; (6) a bulging of the heart shadow upward and to the left; (7) extension of the mediastinal borders as more or less straight lines up to the clavicle; and (8) in some of the acute, fairly large effusions, a hazy, more dense appearance to the lung shadow about opposite the angle of the left scapula.

Death is sometimes due to pressure on the auricles. Paracentesis pericardii often gives marked relief.

MONTANARI, A. Indications and contraindications to roentgen therapy in uterine fibromata. *Radiol. Med.*, 1923, x, 458.

Indications and contraindications in uterine fibroma are based first on the patient's general state; second on the character of the tumor, size, number, location, relations, state of tumor, structure and degeneration; third, concomitant physiological or pathological state of the uterus or other organs, pregnancy, malignancy and concomitant tumors or affections of other organs; fourth, data and dangers relating to these states.

It is indispensable to make accurate diagnosis before starting radiotherapy. The same is true in surgical intervention, which must be resorted to in doubtful cases. Patients under forty years of age suffering from fibroma must not be radiated, because, in the present state of our apparatus and technique, no security can be given of influencing the tumor without injuring the ovaries. Around forty those preferably who are near the menopause may be treated by the rays. Those having reached the menopause may be radiated, but if success is not rapid and complete, they must be passed on to the surgeon. Fibromata of large size passing beyond the umbilicus can be radiated especially with the aim of a partial result and reduction.

The best results are seen in small and medium tumors. However, this does not apply always. One cannot deny the possibility of cures from conservative surgery (myomectomy). The number of fibromata, if not excessive, is not of very great importance, because they generally are in direct connection with the entire fibromatous mass.

Subserous fibromata of the pedunculated type and the submucous, and those located in the ligaments, must be left to the surgeon. The interstitial belong to the roentgenologist.

The intermediary types may derive more or less benefit from radiation according as their characteristics approach one of the two latter types. In incarcerated compressed fibromata roentgenotherapy may be tried if local and general disturbances do not call for urgent intervention. The tumors most recently de-

veloped are the ones that most easily yield to ray treatment. It has not as yet been established beyond doubt whether tumors of muscular or of fibrous prevalence in their structure respond more readily. It is certain however, that in some instances pure myomata as well as sclerotic fibromata are little influenced; and the least influenced are the myoadenomata. The common degenerated fibroma will be left to the surgeon: first—for prudence (cystic degeneration) and from utilitarian reasons (ischemic degeneration); also from necessity (septic and calcareous degeneration). In cases where there is certainty or suspicion of concomitant existence of an epithelioma, roentgen treatment must not be given.

Radiation may be used where sarcomatous degeneration is certain or suspected, but the technique adapted for these tumors must be observed. These cases, when referred to the surgeon, always give rise to dissemination and the result cannot always be predicted.

Pregnancy is always a contraindication to roentgen treatment. Where laparotomy is made for some reason and a fibroma is detected it goes without saying that the tumor should be removed in the same operation. In any pathological state which renders operation especially dangerous, the insistence upon roentgen treatment is ill-advised.

On the whole it is impossible entirely to avoid roentgen dermatatis or adhesions, or sclerosis of the connective tissue, ectasis, or vascular hyperplasia, psychic disturbances in consequence of the menopause, or disturbances in the body resistance in regard to operations and later infections.

Another indication is formed by the patient's fear of operation and his needs, from a social standpoint, of rapid recovery.

MONTANARI, A. Perivaterian duodenal diverticulum. *Radiol. med.*, 1923, x, 445.

A male patient, aged sixty-three, suffered from icterus for five months. For two months he had pain in the epigastric and umbilical regions, which occurred with a certain regularity, and spasmodicity, every eight to ten days, at 10 p.m. It did not radiate to the back. The urine contained some bile pigment. The stools, which had been white, had regained their normal color when he was examined. Appetite and weight were diminished. The previous history was negative. Palpation of the abdomen revealed little that was abnormal, excepting some pain on pressure in the region to the right, and above the umbilicus. The diagnosis of either calculus of the common duct or neoplasm of the head of the pancreas suggested itself. He was operated upon, and a biliary calculus extracted.

The roentgenogram showed no shadow which could be referred either to biliary calculus or to pancreatic disease. The opaque meal showed normal size and shape of the stomach. Peristalsis was normal. When the meal had passed the pylorus and entered the duodenum a circular shadow appeared in the ampulla of Vater, about 2 cm. in diameter. The duodenum appeared normal in size and shape. Pressure in this region caused only slight discomfort. When the patient was examined lying down, the shadow which was circular in the erect position became pear-shaped. It was not homogeneous, but mottled with light spots. After one hour and forty minutes the gastric residue became small, the shadow irregular in outline and the light spaces larger. After three hours the stomach was empty. Barium residue was seen in the duodenum; the abnormal shadow was quite isolated.

Biliary and renal calculi could easily be excluded. The abnormal shadow did not appear during gastric filling but only when the barium passed through the duodenum. The conclusion was that it had some communication with this organ. A diverticulum of a penetrated chronic ulcer was taken into consideration. The case history, however, had revealed no previous disturbances, and gastric roentgenology gave no affirmation. The duodenum was not deformed in its upper part and the cavity under discussion was located in the descending part of the duodenum which is a characteristic site of duodenal diverticula. Two surgeons had expressed the possibility of a dilatation existing in the ampulla of Vater, in consequence of a biliary calculus expelled into the intestine.

A clinical complication of a duodenal diverticulum must be mentioned, namely, chronic pancreatitis.

MORTON, HENRY H. Temporary suppression of urine following double pyelography. *J. Urol.*, Sept., 1923, x, 261.

The history of the case reported pointed to calculus in the left kidney or ureter. Cystoscopy showed a normal bladder. On the right side a No. 6 catheter passed into the pelvis of the kidney; in the left ureter, about 2 in. from the bladder, obstruction was met. The urine from the right kidney had 4 gr. of urea to the ounce. Phythalein appeared in four minutes. It had no pus nor casts, but a few streptococci. The urine from the left kidney was cloudy, and had no pus, casts or bacteria. There were 2 gr. of urea to the ounce. The radiogram showed a small calculus, 1½ in. from the bladder. The pelvis of each kidney

was filled with 25 per cent sodium bromide solution, and pyelograms were made.

Complete suppression of urine followed, and for two days no urine was secreted, in spite of active treatment; and then rapid recovery took place.

This illustrates the danger of a double pyelography, for if the secretion of one kidney is impaired, the other remains to continue the elimination.

During this time the patient looked well, felt well, had no discomfort; the temperature, pulse and respiration were normal.

NEVERMANN, H. Treatment of general roentgen intoxication. *Klin. Wchnschr.*, 1923, ii, 1747.

Sielmann and Schlaginweit gave sodium chloride as enema, 300–1000 c.cm., or 5–10 gm. per os in wafers, or 1 c.cm. of a 5 per cent NaCl solution intravenously. The NaCl content of the serum was seen to decrease rapidly after roentgen treatment for some hours, then to increase again, slowly.

In the Eppendorfer Krankenhaus at Hamburg, sodium chloride has been given with good effect for the last year, generally 5–10 per cent solution intravenously. The size of the dose seems to make little difference. Among 16 cases it failed twice, once in ovarian radiation, for ovarian hemorrhage, and once in cervical carcinoma. It was given, in a few cases per os, generally with excellent effect.

ODEN, RUDOLPH J. E. Diaphragmatic hernia. *Ann. Surg.*, Nov., 1923, lxxviii, 660.

Giffin's report of literature up to 1913 gave references to no less than 690 reported cases, 675 being necropsy findings and 15 diagnosed before death. From 1913 to 1919, Frank found 42 additional cases, and from 1919 to 1923, 96 others, 43 of which were battle casualties. Warren reported 8 cases treated at the London Hospital during ten years, 1 of which lived. Bevan cites 4 cases operated on, 3 of which lived; a total of 840 cases.

In the case reported the test meal passed upward into the chest, marking the diaphragmatic hernia. About two-thirds of the stomach was above the diaphragm. At operation the hernial opening was found to the right of the esophagus through which a portion of the greater curvature protruded. Complete recovery followed.

Hernias of the diaphragm are either congenital or acquired.

The posterior portion of the diaphragm is the last to form. This is probably the reason why the diaphragm is often found incomplete at this point, a condition which permits the formation of diaphragmatic hernias.

True hernias must not be confused with an eventration of the diaphragm.

In the true type, the stomach and colon are most frequently found to be herniated.

In the traumatic type, the possible associated symptoms of hemorrhage, pneumothorax, possible collapse of the lung and shock, may entirely mask the real condition. If the patient survives, irregular disturbances of the digestive tract, dyspnea and cardiac symptoms may occur without any apparent cause.

Epigastric pain directly after eating, inability to take quantities of food, a sense of smothering or precordial pain and distress, and inability to vomit or belch during an attack, are regarded as cardinal signs pointing to diaphragmatic hernia.

OPITZ, E. On life processes in cancers of the female generative organs. *Med. Klin.*, 1923, xix, 1215.

If fatal roentgen-ray dosage could be applied to the carcinoma cells, and the surrounding tissues not be affected, the problem of treatment would perhaps be solved, but as that cannot be done, slow destruction must be aimed at. The author is of the opinion that experiments on unicellular organisms and histologic examination of radiated tumor cells will give the biological explanation for the processes going on in the tumor.

Seitz thinks that biological happenings which tend to spontaneous recovery are entirely unknown to us. No changes could be found in animals which were killed by roentgen rays. The vital processes in the tumor cells are unknown to us. However, even if complete cure of the carcinoma cannot be accomplished, much improvement can be derived from the treatment to the growth of the tumor, and the general state of health. Life may be prolonged, and the capacity for work restored for a longer or shorter time.

The reaction of the tissues depends on the dose, the radiated body volume, the type of tissue which is under ray influence, the dispersed and the direct rays, and probably also on the hardness of the rays. The results obtained in carcinoma have no direct relation to the amount of radiation applied. Recurrences were often seen at the Freiburger Frauenklinik (Director Kroenig) where uterus and mammary carcinomata were treated with carcinoma, or higher, doses. Erythema doses of the second and third degree had unfavorable results.

Occasionally, strongly proliferating carcinoma cells will be found in groups, in the midst of connective tissue which has been rendered necrotic by radiation.

Almost all cancers, excepting those of the female generative organs, will sometimes show bad results. The most unfavorable relatively are those of the intestinal tract. Prophylactic radiation after amputation of the breast for carcinoma has had varying results, according to technique. Perthes and others, who used high doses, have even seen aggravation from them. Others, such as Anschuetz, who used small doses, have seen improvement and lasting recovery. Isolated carcinoma cells cannot be destroyed even with the tenfold carcinoma dose. Hofbauer saw vulvar carcinoma undergo regression after radiation of the hypophysis, as in direct radiation.

In experiments on mice it was seen that carcinoma was hard to influence where the diseased area was carefully isolated. The effect was better when the surroundings were also touched by the rays. Evidently the action of the roentgen rays is not a direct one, with our therapeutic means. The doses are much too small for that. Doses ten to thirty times as large could be expected to cause cell destruction. The effects of local and general radiation are practically the same. The author thinks that chemical substances arise during radiation, and more abundantly at the focus. If the more distant tissues show little change it is because the chemicals form in a diminishing degree with the diminution of the ray influence. In animal experiments connective tissue and blood changes have been observed. The author thinks that genuine recovery is not effected, or that, at least, it cannot be demonstrated by our present-day means.

Pfahler, G. E. Diseases of the lungs studied by the use of the roentgen ray. *Ann. Clin. Med.*, Nov., 1923, ii, 201.

The roentgen ray plays an important part in the study of diseases of the lungs and its results must be considered with other clinical evidence.

The roentgenoscope permits the study of the movements of the diaphragm and the movements of the various portions of the lung tissue, and the effect of the heart beat upon the surrounding lung tissue. It permits rotation and manipulation, so as to bring the best view and to determine the best point of attack in pulmonary abscess. The operator should remain in the dark room at least fifteen minutes before undertaking this work to enable the retina to become sensitive.

Teleoroentgenograms give the best results both anteriorly and posteriorly. In cases of early tuberculosis stereoscopic films are desirable; preferably anteriorly. A special film should also be made of the apices. In these cases the clavicles should be projected downward so as to leave the apex clear for study and comparison.

In advanced cases the roentgen ray shows, as a rule, more extensive lesions than the physical signs would indicate.

Pneumonia can be recognized in all stages. In the study of pulmonary abscess the roentgen ray is almost a necessity. It is also of great value in the study of pulmonary diseases of children.

Sasso, E. Saffron in roentgenography. *Radiol. med.*, 1923, x, 480.

Prof. R. Namias, Director of the Photographic School, in Milan, working on the basis of the discoveries of Cramer, made in 1921, and the work of Ludwig and Lumière, has found valuable methods to facilitate developing of plates. Saffron, in great dilution, desensibilizes the sensitive layers of the photographic plates, and makes their handling easier. It is a well-known fact that roentgen rays act uniformly on all layers of the emulsion. Saffron makes longer development possible, improves underexposed plates, and chemical veiling is lessened. The deep developing is perfected, and produces more contrasts in the plates. Details are brought out more clearly. Exposure can be reduced to almost half the time. The reinforcing screen can be used with it.

Schroder, J. Henry. Massive neoplasm of the lung with paralysis of the diaphragm. *N. York M. J.*, Nov. 21, 1923, p. 628.

This patient was fifty-nine years of age. His previous history suggested nothing of interest in connection with his present illness.

He was first examined in November, 1921, and again on April 4, 1922, when a decided increase in the morbid condition was noted. The loss in weight in that period had been about 11 lbs. The affected half of the right lung showed complete dulness on percussion and pronounced bronchial breathing on auscultation, an occasional feverish temperature toward evening, and shortness of breath, quite intense upon slight exertion. The complement fixation test for tuberculosis was negative. The blood examination showed only secondary anemia. The roentgenogram shows a well-circumscribed, deep shadow, quite extensive, apparently in the upper half of the right lung, affecting the upper lobe and part of the middle lobe. Roentgenoscopic examination showed marked contrast in the respiratory expansion of the sound left side and the affected right side. The diagnosis was made of pulmonary tumor, and that it was probably of a carcinomatous character.

The patient says that he coughed only moderately. The surface lymphatic glands were not enlarged. There was very limited chest expansion on the right side and no evidence of pleural exudate.

Stereoscopic lung plates revealed a dense infiltration of the parenchyma of the upper half of the right lung, fusing with clearer lung tissue of the lower part of the lung. The right side of the diaphragm was elevated and immobile. The paralysis can be accounted for by the almost inevitable compression of the phrenic nerve above. The condition of the patient indicated the malignant character of the new growth. Irradiation was undertaken because of the still comparatively good condition of the individual that promised good resistance.

On April 14, 1922, the minimum carcinoma dose of Wintz, that is, 100 per cent of the surface erythema dose of the ultra-hard roentgen ray at 200,000 volts maximum, to the tumor mass in the lung, was administered in one treatment. One large area of entrance in front and one in the back were used, corresponding to the area of lung involved. Seven days later an additional 30 per cent of the carcinoma dose was administered through an available area that had not been exposed during the first irradiation.

The systemic effect of the irradiation was mild. Increased cough and tightness in the chest became evident in twenty-four hours and subsided in the course of a week. The surface irradiation erythema was mild, and with subsidence of systemic reaction, the patient's condition improved visibly. He gained 2½ lb. in ten days, and continued to improve.

On June 6 and 9, 1922, the second dose was administered, with the following difference in technique: in order to obtain the greatest homogeneity of radiation, doses of 100 per cent of Wintz units were administered to the upper portion of the tumor and to the lower portion, including the hilus region, three days apart.

On November 15th, roentgenographic examination showed only a slight increase of density of the shadow on the right as compared with the left.

A re-examination on February 1, 1923, one year after the irradiation, revealed the lung still entirely free from recurrence of tumor and any tendency to fibrosis.

Hines has reported a case of a spindle-celled sarcoma of the lung which was subjected to roentgen irradiation three times in four months. During the last series of treatment respiratory distress developed, and several days later, death occurred. Post-mortem histological examination revealed an extensive fibrosis of the lung. All parts of the lung were consolidated from proliferation of connective tissue in the alveolar walls, with resultant great decrease in air space, which accounts for the dyspnea cyanosis, and death.

SUTHERLAND, GEORGE FRED and MITCHELL, JAMES HERBERT. Effects of treatment of bone lesions in congenital syphilis. *J. Am. M. Ass.*, Nov. 24, 1923, lxxxi, 1752.

Osteochondritis syphilitica is the most common and characteristic bone change in the syphilitic fetus and in the new-born infant.

Various observers have noted this change which varies from 70 per cent to 93.4 per cent. Shipley and his co-workers found in 100 supposedly normal infants 15 with advanced syphilitic osteochondritis, 10 with less marked changes, and 21 with changes strongly suggestive of syphilis.

It is best seen in the fetus or in the infant under three months of age.

In the first stage, the calcified zone between the epiphysis and the diaphysis widens to a breadth of 2 mm., as a white or pink line. In the second stage this may be increased to 4 mm. Necrosis of the bony trabeculae occurs. In the third stage the periosteum and the perichondrium become thickened in the epiphyseal region. Separation of the epiphysis from the diaphysis frequently takes place along the line of necrosis, and pathologic fracture may result.

The bones most commonly affected are, the lower end of the femur, the distal and proximal ends of the tibia, the distal ends of the radius and ulna, the extremities of the metacarpals, the proximal ends of the phalanges, and the proximal ends of the ulna and radius.

There were 18 cases of congenital syphilis of infants. Nine of the infants had symptoms of bone disease.

The usual treatment was from six to eight weekly injections of neoarsphenamin, in doses up to 0.15 gm. intravenously or intramuscularly followed by eight or ten weekly intramuscular injections of mercuric salicylate in oil, in doses from one-fifth to one-third grain. This was followed by a rest from treatment for from three to five weeks, and then a Wassermann test was made and the course was repeated.

The symptoms of bone lesions decreased after the first injection of neoarsphenamin, and usually disappeared within a month.

As the roentgen-ray findings disappear in the absence of treatment, it is difficult to determine whether or not the improvement is more rapid with treatment.

Under this treatment the roentgen-ray picture slowly returned to the normal. The periosteal changes are slower to return to normal. However, within a few weeks the narrow, clear area between the cortex and the periosteum becomes less distinct.

In older children, from three to fifteen years the bone process is more often a periostitis with or without a gummatous osteitis.

In the abstracts of the discussion of this article, Dr. Mitchell says: "The bone changes in rickets are somewhat similar but they do not develop until some months after birth. Therefore, the roentgen-ray examination of the long bones is probably the most valuable method of diagnosis of congenital syphilis at the present time."

Wood, Francis C. Further studies in radiation dosage. *J. Radiol.*, Oct., 1923, iv, 343.

The great need in radiotherapy is the means of accurate dosage.

Some are still treating internal cancer with ten- or fifteen-minute exposures with a filter of 3 mm. Al and an 8-in. gap, but without the slightest idea of the erythema dose of their machine or the effect of the radiation penetrating the deeper tissues. If they accomplish anything, they stimulate rather than inhibit the growth.

Experiments were made in The Crocker Institute of Cancer Research with a commercial machine running at 170,000 volts. This voltage was very carefully determined by a physicist using a 25 cm. sphere spark-gap and the standard potential tables for an instrument of these dimensions. The wave forms and current curves show that the voltage and current were in phase. The only variable was the position of the switch on its axle.

Repeated determinations of human erythema doses with the apparatus thus adjusted have shown that, on an average, 45 minutes with a 40 cm. skin-focus distance, 5 ma. through the tube, ½ mm. of zinc plus 1 mm. of aluminum filter, will give a dose which is just short of an erythema. Forty-eight minutes is a good erythema on sensitive skins, and 50 minutes gives a fairly sharp reaction in ten days on insensitive skins.

The death point of the tumor which was used as a standard (Crocker Fund Tumor, N. 180) was found to be 250 minutes under these conditions, that is, five erythema doses. Scatter was eliminated, the tumor being supported upon thin gauze from any substance which might give secondary rays.

Assuming, therefore, that the tumor is killed without scattering with five erythema doses, it is interesting to observe the effect of some substance whose absorption capacity corresponds approximately to that of human tissue.

With 10 cm. of block paraffin, 10 cm. above the tumor, with a 10 × 10 cm. field, the exposure was 675 minutes. The paraffin absorbs 63 per cent of the ray. These conditions do not apply in human therapy, as the tumor is always in contact, on one or both sides, with substances of low atomic weight which give a large amount of scattered radiation. Experiment demonstrated that the dose under these conditions fell to almost four erythema doses.

This particular tumor is some three and a half to four times as resistant as a human basal-cell carcinoma.

When the tumor tissue was placed between two blocks of paraffin, 10 cm. thick, the rays were allowed to strike the tumor through a 10 × 10 cm. opening, the skin focal distance being 30 cm. and the distance to the tissue 40 cm., the dose was 360 min. instead of 675, thus showing how important a factor the scatter is even through a comparatively small opening. This dose in impossible for human cases since the skin would receive some 20 erythema doses.

When the lead opening was increased to 18 × 18 cm. all the tumor cells were killed at 240 min. exposure, or 8.5 erythema doses to the skin. This is still an unfavorable working condition. If, however, the skin focus is changed to 40 cm. instead of 30 cm., the tumor then being 50 cm. from the anticathode, we get a death point of all the cells in 320 min. with 6.4 erythema doses on the skin.

Thus we see that a much better depth effect is oftained by using a longer skin-focus distance.

We do not yet know whether human intestine or other hollow viscera will stand four erythema doses. Not more than four erythema doses have been given to a deep-seated tumor, that is just two thirds the amount required to kill the mouse tumor, No. 180.

Some very interesting observations with roentgen ray derived from a continuous current of high voltage will be reported later on.

Woodcock, H. M. A modification of Dr. Charles Creighton's view of malignant growths. *J. Roy. Army Med. Corps*, Oct., 1923, xli, 241.

Reasoned imagination based upon considered observation is what is needed to-day in the study of many diseases of whose mode of causation we are still ignorant.

The necessity for a comprehensive knowledge of the biology of tissue cells, if the cancer problem is to be successfully attacked, is now

generally recognized. By cell biology is meant the mode of life and especially of nutrition. It is essential to remember that the tissue cells are individual units, specialized homologues of unicellular animals.

Many types of tissue cells are accustomed normally to digest or metabolize blood elements, especially the red blood corpuscles. This function is called hemetaboly, and may be preceded by actual ingestion (hematophagy) of the cells,or it may take place extra-cellularly.

In its beginning, malignancy is rather a biological reaction than a pathological process. The cancer cells may be regarded as recuperated cells, which have acquired a fresh (if spurious) lease of vital activity. The disease results from the effects, both upon the body politic and on themselves, of their excessive and unrestrained multiplication and spread. And the essential factor in the causation of this malignant condition is the independent re-acquirement, by certain individual cells, of the capacity to assimilate the products of hemetaboly entirely for their own use, instead of performing their normal bodily function in this respect; in other words, they have reverted to the condition of free, single cells.

The main emphasis is that normal hemetaboly is not, in general, for the benefit of the cells themselves, but for the body as a whole, and its use for their own growth or multiplication is most stringently controlled. Normal hemetaboly is the key to the understanding of the malignant condition.

Numerous instances are given of cancer cells which had engulfed corpuscles and other blood elements but also other cancer cells.

Hematophagy was found without difficulty in malignant growths, cancer-cell nests being formed from this habit.

BUCKY and KRETSCHMER. On roentgen treatment of infantile pulmonary and bronchial glandular tuberculosis. *Ztschr. f. d. ges. physik. Therap.*, 1923, xxvii, 119.

Deep roentgen radiation has caused satisfactory improvement in children with bronchial glandular tuberculosis, and in some instances of pulmonary tuberculosis. With this treatment, no change in the mode of living was necessary. The effect is often much more lasting than the effects from change of living. The general state of health improves, weight and appetite are increased, and the children are mentally brighter.

BUMM. On roentgen carcinoma in the woman. *Verb. d. Ges. f. Geb. u. Gyn. Berl. Ztschr. f. Geb. u. Gyn.*, 1923, lxxxvi, 445.

It is well known that cutaneous cancroid may develop on the skin on the site of chronic roentgen dermatitis, which will have all the characteristics of malignant neoplasms and which by metastasis may cause death. Hesse, in 1911, published 94 of these cases. Lazarus later published 100. Generally these injuries were seen in persons handling roentgen rays professionally, and the lesions formed a parallel of those caused by tar or paraffin, or of the chimney-sweep cancer. Among the reports there are only 4 cases where the cause was therapeutic. It seems that acute manifestations are not so likely to form these cancroids as the chronic skin lesions caused by repeated small doses. Unless this were the case, one would find cancroid developing frequently on the abdominal wall in women.

A case of a woman, aged sixty-one, suffering from itching of the genitals, had been treated without success for years by means of ointment and compresses. During the menopause her condition became much worse. After the first roentgen application there was a decided aggravation; therefore, ointment and powders had again to be resorted to. Later, she was radiated for a year and three months, every two to three weeks, for ten or fifteen minutes, and four times radium was applied. Nine months after the treatment had been stopped, roentgen burns were found. Chamomile compresses and sun baths were of no avail. The entire genital region to the anus and the inguinal poles ulcerated, and the borders developed scirrhous stratified epithelial carcinoma. The vulva, clitoris, urethra, and hymen were not affected. The skin over the entire diseased area of the pathological tissue was removed, but a few months later recurrence set in.

Treatment should be made about three to six months after the necrosis is well divided off from the deeper layers, and complete surgical removal will be necessary.

Several times the author has seen carcinoma of the uterus develop after roentgen treatment, in cases where he was doubtful whether carcinoma and myoma had developed simultaneously, or were the consequence of chronic roentgen irritation.

CORICA, A. Influence of roentgen rays on the respiratory metabolism of tuberculous children. *Pediatria*, 1923, xxxi, 868.

It was found that roentgen treatment of tuberculous children has a definite influence upon the respiratory quotient when the rays are applied to the lateral cervical region and the spleen, or the lateral part of the chin and the spleen, or the ribs and the lateral part of the knee. In some the anhydrid carbonic elimination was diminished, and the oxygen resorption

increased. More oxygen was utilized. In 2 other cases there was a greater increase of carbonic anhydrid elimination, and the oxygen absorbed was less. However, in either instance, oxygen metabolism, or combustion, was improved. This influence upon the gaseous mechanism is similar to that experienced from the sun rays.

DOEDERLEIN, A. Therapy of gynecological cancer with radioactive substances. *Strahlentherapie*, 1923, xv, 766.

It cannot yet be definitely decided whether radium and mesothorium are equal, in their effect, to roentgen rays. They have the advantage of being harder than any rays so far produced by roentgen apparatus. Their scope of appliance, however, is more limited. The application does not take so much time as roentgen therapy, and does not cause the same high expenditures in the long run. The life of radium has been estimated at eighteen hundred years, and that of mesothorium at twenty years. The latter disappears in this span of time, down to a 25 per cent radium content. This vivid combustion going on within mesothorium may perhaps indicate that it acts somewhat differently than radium.

From 1912 to 1918, 1,016 women were treated with these substances. Among these, 962 were suffering from carcinoma of the female generative organs. The neck of the uterus was involved in 755 cases. All of these have been observed for five years. The results are that 103 of these cases have remained cured. This would amount to 13.2 per cent. Abdominal and vaginal extirpation of carcinomatous uteri gives an operative cure of 20 to 25 per cent. It would, however, be wrong to conclude that radiation with these substances is only half as valuable as operation. The patients treated by these substances are much more unfavorable cases than those applying for operation. Among the total number, there were only 110 which were operable. Of these 110 cases, the radioactive substances cured 48, which would amount to 43.6 per cent. There were 136 cases which were doubtful as to their operability, and of these, 22 per cent were healed. Among those who were entirely inoperable, 340, 6.7 per cent were healed. Even among the group of 169, which were desperate, 1 was cured. Among 65, vaginal carcinomata, no cure was affected by rays. It seems that in this region carcinoma spreads so rapidly into the surrounding tissues, that success is almost excluded. The same failure was registered in 14 cases of ovarian carcinoma. They all had to be operated on, and only 1 case was cured. One among 17 of vulvar carcinomata was cured, and none of 7 urethral carcinomata. Evidently, radiation fails here in the same manner as does operation. It may be that sensibilization of the carcinoma can be effected by applying the rays to the hypophysis.

EIKENBARY, C. F. Fractures through the lower epiphysis of the humerus occurring in children. *J. Am. M. Ass.*, Jan. 12, 1924, lxxxii, 78–83.

This report is concerned entirely with fractures in children, occurring through or just above the lower epiphysis of the humerus. Report is made of 21 cases wherein treatment is entirely finished and the results known.

In 19 of the cases there was backward displacement, a few complete with overlapping. In the majority, there was not only backward placement, but some lateral displacement as well. In 3 instances, the lateral displacement was also complete. In only 2 cases was there a forward displacement of the epiphysis. In none of the cases was there any nerve involvement or circulatory disturbance. Twenty of the fractures were reduced without open operation; 1 case was reduced by open operation. Of the 21 cases in which the end-results are known, 20 are perfect, by which he means that there is no disability of which the patient is aware.

Treatment. A roentgenogram is first made in order to determine accurately the type of fracture, the degree of displacement and the amount of comminution. Unless the roentgenogram indicates that attempted reduction, by the closed method, is very likely to fail, he proceeds immediately with the reduction. No delay is made to permit of swelling to disappear. He feels very strongly that the quickest way to get rid of the swelling is to restore normal anatomic relations. Reduction is attempted under general anesthesia and under the roentgenoscope, and never any other way.

In fractures of the lower epiphysis of the humerus, the lower fragment to all intents and purposes becomes an integral part of the forearm. Keeping this in mind, he makes no effort to reduce these fractures by traction alone, a method that is almost sure to fail. He uses the same method as in the reduction of a Colles' and many other fractures. With the elbow firmly grasped, the movements of the parts closely watched on the screen, the existing deformity is greatly increased until the fragments may be unlocked and the edges made to slide past each other. The reverse procedure is then carried out, the lower fragment sliding forward and the elbow being flexed at the same time. It may be necessary to go through this procedure several times

before a satisfactory replacement can be obtained. The same method of angulation and reversal of procedure is used to correct a lateral displacement. The arm is then put up in a molded plaster splint, although adhesive strips may work equally well. Usually the elbow is put up in acute flexion, but not always. Perhaps it would be better to say that it is put up in that position in which, under the roentgenoscope, it can be best maintained.

Formerly, he started physiotherapy in these cases as early as the tenth day. No harm came from this procedure, but little or nothing was accomplished. He now makes it a rule to start physiotherapy at the end of three weeks, unless the roentgenogram indicates that such a procedure would be unwise. He makes use of a well-trained physiotherapist. The length of time required for the physiotherapist to develop the maximum amount of motion is most variable. It ranges anywhere from a few weeks to several months.

He believes that the hardest factor to overcome in the development of motion is not adhesions, but muscle spasm. Relaxation is always difficult, and not infrequently taxes all the skill of the trained physiotherapist. It cannot be overcome forcibly. A long and patient study of muscle spasm is well worth while to the surgeon who is going to treat elbow fractures successfully.

FRIEDBERG, E. and SCIMONE, V. On the effect of ultraviolet rays on antibodies, antigens and the components of the Wassermann reaction. *Ztschr. f. Immunitaetsforsch. exp. Ther.*, 1923, I part, Orig., xxxvii, 341.

When hemolytic serum is radiated with ultraviolet light the amboceptor diminishes in proportion to the effectiveness of the serum, the attenuation and the albumin content. The albumin fraction is more resistant than the globulin fraction. The last part of the complement is more resistant. In eel serum the lytic function is more resistant than the toxic. Trypanosoma lose their infectivity much sooner than their motility when radiation is applied. Wassermann and Sachs Georgi positive sera of man and rabbit when radiated, and more especially when diluted and shaken, become negative. Radiation has no influence on negative sera and extracts.

GUARINI, CARLO. Roentgenologic research of the sella turcica in some ocular lesions. *La Riforma Medica*, 1923, xxxix, 892.

Papillitis may be of various origin—syphilitic, meningitic, tuberculous, it may be a diffuse process, acute infection (influenza, pneumonia, scarlatina), dyscrasia (diabetes, albuminuria, urticaria), lead poisoning, acute anemia, profuse loss of blood, lactation, menopause, hereditary. Stasis of the papilla is recognized by oculists as a sign of cerebral tumor, strabismus as a sign of increased intracranial pressure.

Often the oculist finds symptoms in the fundus of the eye which may suggest various morbid states. Exophthalmos is supposed in some cases to have arisen from trauma, which one, however, may not be able to trace. If roentgen rays are employed, the sella turcica may be found changed and a tumor of the hypophysis diagnosed.

The Coleschi technique is used for this purpose. Plates at 50 to 70 cm. distance from the anticathode.

The anteroposterior plane of the head must be exactly parallel with the plate. The head must be perfectly immobile, patient being advised to hold his breath. The rays must pass through the axis of the sella turcica. This point will be one which connects the center of a line going through the outer angles of the eyes and the upper border of the external auditory canal. Medium hard rays and exposure as short as possible. In the lateral projection, the sella turcica will be found about the center of the plate, if the pose is correct, immediately to the right of the anterior cranial fossa. It is semicircular with concavity upward, and shows a slight protuberance, the pituitary protuberance. It may form half a ring, or three-fourths, or almost a complete ring, or may form three-fourths of an oval, more or less elongated with longest axis in any direction, but always in the same sagittal plane. It may be rectangular, of which the anterior wall of the sella turcica, and the lamina quadrilata form the smaller sides. Behind, the sella turcica is limited by a vertical shadow. The pituitary tubercle is always well demonstrable in the newborn, in the adult it is hardly distinguishable.

Roentgen-ray diagnosis will often clear the etiology of blindness, and all cases should be subjected to this diagnosis.

SLUYS, M. Creation of multiple points of beta secondary rays in the midst of the tissues with a therapeutical aim (deep beta therapy). *Comp. Rend. de l'Acad. des Sc.*, Oct. 22, 1923, lxxvii, 800.

We have thought to create in the midst of the tissues an intense beta raying, in order to obtain a maximum biological effect.

The physical base of the technique is the following:

The maximum emission of the secondary beta rays for a given element, is when it is irradiated by a roentgen ray of a length slightly shorter than that which corresponds to a

cessation of absorption of the element in question. We have employed metals of high atomic numbers, such as platinum, gold, bismuth, and uranium, of which the length of wave is very short, and the emission beta of an intense maximum. These permit us to obtain with waves of short length, on the one hand, considerable penetration, and on the other a very important emission of free electrons in the midst of the tissues.

Practically we have plunged into the regions to be treated, needles and supple or rigid threads, in pure metal or plated, or impregnated with insoluble salts of gold, platinum, bismuth or uranium, and have irradiated the region with roentgen rays of a wave-length corresponding to the maximum beta emission for each element. This irradiation was given with a Coolidge tube actuated by a constant tension, this tension being chosen to create the maximum of the wave-length to produce the maximum beta emission from the element selected. The threads or needles could be removed or allowed to remain after the irradiation.

The microscopic examinations and the histological sections recalled the effect produced by radium needles used in the treatment of tumors by curiepuncture.

TYLER, ALBERT F. Carcinoma of lingual thyroid with metastasis in the lungs. *Jour. Radiol.*, Nov., 1923, iv, 381–384.

By lingual thyroid is meant an aberrant thyroid, located in the root of the tongue; the most frequent location being in the posterior aspect, above the thyroid bone; of 45 cases reported, 41 were in females, and 4 in males.

The leading symptom is a feeling of pressure in the throat with difficult swallowing or breathing. Medical treatment has had but little beneficial effect. Roentgen rays or radium have not been tried on normal lingual thyroid. In the case reported surgical removal was impossible, and malignant change had taken place. Roentgen rays and radium were used with benefit. Metastasis had occurred, so that complete cure was impossible even by radiation. There have been no surgical deaths in the cases reported.

Healing has been rapid and complete, and the patients have quickly returned to their customary employment. It is important to determine before operation, the presence of thyroid in the normal location, to avoid myxedema. In the case reported, the disease extended over eight years. Roentgen-ray examination showed that there were some thirty nodules of metastasis, scattered through both lungs.

Surgical enucleation is the best treatment, roentgen-ray and radium treatment being beneficial in inoperable cases.

ZIEGLER. Roentgen treatment of laryngeal tuberculosis. *Beitraege z. kl. d. Tub.*, 1923, xvi, 182.

Roentgen treatment of laryngeal tuberculosis was first tried in France with good results and in Germany a few successful treatments had been reported. Only since roentgen treatment has been extensively used for pulmonary tuberculosis has application been made to the larynx. For the last two years the author has used it in certain types of throat trouble. He reports on 50 cases.

This is a provocative therapy, similar to krysolgan in its effects, but more powerful. It must be used only in patients with good reaction. Ulcerative destruction of the larynx forms a contraindication. It is indicated where the infiltrative process in the lungs is not too pronounced, and where the temperatures are satisfactory. Where used tentatively painful deglutition was much improved by two or three treatments. The anatomical state was not influenced, however.

Series of six treatments were made, two a week. The filter was 3 mm. thick, and consisted of aluminum. It was used ten times. After six treatments an intermission of three weeks was made. The rays were applied from the front or the side, as required by the site of the disease. Krysolgan was administered simultaneously. No fever or severe general reaction was experienced from this treatment. Some patients had a scratching sensation and slight discomfort in the larynx which soon subsided. On subsequent applications this was not felt. Slight hyperemia occurred in one instance. Swelling and pain stopped very soon.